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ABSTRACT

The connection between the major research universities and the federal government in furthering advanced learning of high quality was reassessed during a series of meetings of the presidents of 15 major universities. It is argued that one of the decisive elements in the quality of a society is the level it is able to reach and sustain in the quality of its research and scholarship, a national need for excellence in higher learning which cannot be met without a renewed and strong partnership between major research universities and the federal government. Serious limitations in international competence exist in American universities in terms of language instruction, specialized libraries, and collaboration between American scholars and scientists and those in developing countries. The long-term international effectiveness of the United States would be substantially enhanced by the achievement of full international competence on the part of the major American research universities. Without federal assistance even the competence achieved since World War II will erode. Recommendations include: (1) under the International Education Act or other appropriate authorizing legislation, the federal government should develop a ten-year program of grants in support of plans by individual research universities for achieving and maintaining greater competence in research on foreign areas and international problems, and that these grants be awarded on the basis of demonstrated merit; (2) federally funded fellowship programs should support the advanced training of graduate students and the work of postdoctoral scholars in international studies; (3) a comprehensive federal fellowship policy should be developed; and (4) funding for present and future federal programs designed to increase our national competence in international studies should be increased by $75 million a year. (CC)

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# Research Universities and the National Interest

## A REPORT FROM FIFTEEN UNIVERSITY PRESIDENTS

DECEMBER 1977

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# CONTENTS

*Preface* v

An Overview: The Federal Government and the Major Research University, Indispensable Partnership for Excellence 3

The Critical Role Of Basic Scientific Research 23

Graduate Education: Priorities for the 1980s 63

The Major Research Libraries: Strengthening a National Heritage 89

Helping the Research Universities Achieve Competence in International Studies and Research 108

*A Note on the Preparation and Authorship of This Report* 139

# PREFACE

The relations between the needs of the nation and the responsibilities of organized education are massive and complex. The report we present here is the result of an effort by one group of educators to address a relatively small but crucial part of those relations: the places where the national interest and the consequent responsibilities of the federal government intersect with the special capabilities of the nation's major research universities.

This report results from a series of meetings of the presidents of fifteen major universities. Sharing our belief that the general question of relations between the federal government and the major research universities is important, several private foundations helpfully sponsored four working sessions at which we could address these problems. The foundations participating were the Carnegie Corporation, the Lilly Endowment, and the Ford, Hewlett, Mellon, and Sloan Foundations.

Our small group of individuals cannot claim to speak for a constituency as large as the research universities of America, but together we do have knowledge of large and small institutions, public and private ones, and a broad range of specific relations with the government.

The greatest single danger before the world of education, in its relations with government, is that it may divide against itself—public against private institutions, universities against colleges, higher education against the schools. So we should begin by declaring our determined opposition to such conflict. In the long run the world of education is deeply interdependent; its parts

cannot prosper at one another's expense. As presidents of research universities we are responsible for undergraduate colleges, and we have our full share of concern also for the health and strength of the country's schools. In other forums and in other ways we all try to help the cause of education as a whole.

We do not think it inconsistent with this general interest that we should here address a set of issues that is more specialized. We would hope to have this report and its arguments measured in terms of the welfare of the educational enterprise as a whole. There can be no blinking the fact that we are believers in a renewed and stronger partnership between the government and the major research universities and that, because of the inescapable financial realities of the situation, we believe a modest increase in federal funds must be part of that renewal. Our arguments do serve some of the needs of our own kinds of institutions and of the people who work in them. But if they do not also serve the general needs of education, they should not prevail.

Indeed, we ask that these analyses be judged by a still harder and broader test: the interest of the nation as a whole. The case for federal action does not, in our judgment, rest on the fact that our institutions have certain needs—there are many such needs which no one of us would think appropriate for federal concern. The basic responsibility of our institutions for their own survival in freedom is one that we do not wish to transfer to the federal government.

What we here address instead is a limited set of issues in which our free society, as a whole, has an interest that can be protected *only* by the partnership whose renewal

we urge. It is the national interest, not ours, that should determine the matter.

We believe that the general arguments here developed are largely in step with the thinking of our colleagues and friends in other research universities. Much of what we understand of these matters has been learned from such colleagues, as well as from scholars and administrators in our own institutions. We also are certain, however, that the analyses here offered can be refined, extended, and generally improved by the comments and criticism of others, which we invite, as indeed we invite help from everyone who shares our belief that these matters are important.

But we do not wish to end with disclaimers, however justified. We believe deeply that the issues here addressed really are of major importance to the future quality of American life. We do not apologize for raising them; we would be false to our own deepest obligations if we did not seek to have these issues and our response to them presented as clearly and persuasively as we can.

DEREK C. BOK, *Harvard University*
WILLIAM G. BOWEN, *Princeton University*
KINGMAN BREWSTER, *Yale University**
ROBERT CHRISTY, *(Acting President) California Institute of Technology***
JOHN E. CORBALLY, *University of Illinois*
DALE R. CORSON, *Cornell University**
ROBBEN W. FLEMING, *University of Michigan*
WILLIAM C. FRIDAY, *University of North Carolina*
RICHARD W. LYMAN, *Stanford University*
C. PETER MAGRATH, *University of Minnesota*
WILLIAM J. McGILL, *Columbia University*
DAVID SAXON, *University of California*
JOHN C. WEAVER, *University of Wisconsin**
JEROME B. WIESNER, *Massachusetts Institute of Technology*
JOHN T. WILSON, *University of Chicago*

**left the presidency in 1977*
***Harold Brown attended the first two meetings.*

# Research Universities and the National Interest

A REPORT FROM FIFTEEN
UNIVERSITY PRESIDENTS

# An Overview

## THE FEDERAL GOVERNMENT AND THE MAJOR RESEARCH UNIVERSITY, INDISPENSABLE PARTNERSHIP FOR EXCELLENCE

This report is an argument for a reassessment of one of the most complex and important of all the relations that mark our pluralistic open society: the connection between the major research universities and the federal government in furthering advanced learning of high quality. That relationship has been extraordinarily productive. It has no close parallel elsewhere in the world. It has been less effective in the last eight or ten years than in the twenty-five before. And it faces new tests that are the consequence of the continuing explosion both in knowledge itself and in what is now required for new progress in science and other kinds of scholarship.

Our report is not an essay on the financial plight of the academy, although the general financial stress in colleges and universities is relevant to our theme. Nor is it a study of higher education in its undergraduate phase. That subject also has close connections with federal policy,

and nothing argued here should be interpreted as hostile to the national effort to open the whole of our diverse world of undergraduate colleges to all who can and will learn there. The undergraduate college, whether or not it is part of a university, is the necessary source of talent for the higher learning as for other professions. Finally, this is not an essay on the administrative relations between government and the universities, although that too is an important and complex topic. Our concern here is with a subject both broader and sharper than any of these—a national need for excellence in higher learning which simply cannot be met without a renewed and stronger partnership between our major research universities and the federal government.

Our basic premise is that one of the decisive elements in the quality of any society is the level it is able to reach and sustain in the quality of its research and scholarship. First-rate scholarship alone does not assure the future of human dignity; the example of pre-Hitler Germany is proof. But what is insufficient is still indispensable, and certainly the American university tradition of excellence combined with freedom is one important strand in the more general freedom of our society as a whole. If the amount of first-rate research and scholarship achieved in American society should decline—as it is in danger of doing today—the next generation of Americans will be poorer in spirit, and also in pocketbook.

While this prediction seems to us inescapable, we do not think it easy to prove, nor do we suppose that all research is quickly profitable. It is not clearly and empirically demonstrable that every research laboratory

enhances the quality of life or that every great library ensures the survival of freedom. Yet specific examples exist in abundance. We know that without modern biochemistry the practicing physician would be less able to help the sick, and we know that modern biochemistry rests on the imaginative basic research of a few of the best minds of the last two generations. We can demonstrate that the new patents of each decade of our increasingly technological society have their roots in basic research done years before. We can also point to a complex and constructive set of connections between, on the one hand, university work on China and Russia and, on the other, our ability to cope with these societies in our foreign relations.

First-rate work in any field of human action is rare and difficult, but nowhere is the quality of work more plainly decisive than in higher learning and research. It is hard to tell in advance who will do first-class scholarly and scientific work. Sometimes such work is recognized only slowly. Moreover, when a problem is extraordinarily resistant, even first-class work can fail. But none of these qualifications detracts from the force of the proposition that it is quality that counts. In the simple words of Philip Handler, president of the National Academy of Sciences, "In science, the best is vastly more important than the next best."

To accept that test is in no sense to abandon a democratic concern with the rights of all—and especially concern for equality of opportunity in the pursuit of first-class learning. It is nonsense to suppose a conflict between democratic values and extraordinary achievement. It is in the very nature of scholarly excellence that

it accepts the test of free competition in ideas. As long as opportunity is open, achievement in higher learning is as consistent with democratic principles as any other form of excellence. From the days of Ben Franklin to the latest announcement of Nobel Prizes, democratic Americans have honored such excellence.

At the same time that it is rare and difficult, which has always been true, first-class research in all fields in the last two generations has become steadily and rapidly larger in scope, deeper in necessary specialization, and enormously more expensive. As little as fifty years ago it was still possible for a great physicist to know nearly all of physics and for his work, even if it was experimental and wide-ranging, to be supported by the very limited research funds available in the universities and research institutes of the day. The foundation of modern physics was laid in that generation, here and abroad, by scientists whose most expensive equipment had a cost less than one tenth of one percent of what is required today to build a single particle accelerator. What is true of physics is true also, in different ways, of nearly every field of higher learning. The expanding universe of knowledge and investigation has brought with it an inescapable connection between first-rate equipment and first-rate results. There are still great investigators whose only immediate material requirements are pencil and paper, but even these scholars usually require access to complex special libraries, facilities that again are vastly more expensive than their counterparts of fifty years ago.

Over most of the years after World War II the United States benefited from an extraordinary expansion in the quantity and quality of its scholarship and research. As

we show later in this report, this expansion brought new levels of expense for all concerned, but the most dramatic expansion of all was a twenty-five fold increase, in constant dollars, in the level of federal support for basic scientific research. The same period saw at least a tenfold increase, mostly without federal support, in the annual budgets of the fifty-eight largest libraries in the country.

Since 1968, in constant dollars, there has been a slowdown in the support of all research and scholarship—and in basic scientific research even a reduction of spending—with grave consequences to which we shall return. Meanwhile the irreversible explosion in the cost of excellence continues. While no one can claim that every research dollar is well spent, the general austerity of today's academy exerts a constant downward pressure on all costs which gives at least modest assurance that, in the main, expansions in the cost of higher learning reflect only what is necessary for excellence. Even in the easiest days of academic expansion, even the richest of our universities faced hard choices imposed by the enormous distance between what the best scholars could profitably use and what society had given them. Comparatively speaking, in the years from 1955 to 1965, the great universities had financial support for the research carried out by their faculties at a level never reached before or since, but in absolute terms, even then, their budgets fell far short of what was needed to make the most of their abilities.

What makes it right to argue these matters mainly from the example of the major research universities is that these institutions have been and still are the determining sources of excellence in American science and

scholarship. Quantitatively their share in the nation's research is large but not overwhelming. The forty universities with the largest expenditure for basic scientific research in 1974 accounted for just under a third of the total national effort, and all colleges and universities taken together spent only 54 percent of the total.[1] But more important than this measure of the amount of research conducted is another: the major research universities are the dominant source of the investigators of each generation. More than 99 percent of these scholars and scientists get their advanced training, after college, in the doctoral programs of the nation, and most of the best doctoral programs (although not all) are to be found in the forty or fifty leading research universities.

Still more important in determining the sources of excellence is the qualitative test. There can be little doubt, from the very nature of the behavior of outstanding students and investigators, that excellence attracts excellence. Great libraries and laboratories are magnets with high drawing power of their own, but more important still are the great men and women. Fortunately for the nation, and for themselves too, the truly great scientists and scholars are not all in one place, or in ten. No one institution is as nearly preeminent as Harvard or Chicago or California may have been at different times in the last fifty years. The set of universities that lead our higher learning is now truly national in number and location.

This set of institutions is the fountainhead of our first-class science and scholarship. In the United States more than in any other modern society, the quality and quantity of excellent advanced study are dependent on

the quality and quantity of what is done in the major research universities. These institutions are at once the necessary center of nearly all doctoral training and the natural home of a great majority of the most distinguished research scholars of each generation.

The research university has three great advantages over the research institute that is the dominating force in the research and scholarship of some other countries, notably the Soviet Union. First, it creates an inescapable connection between research and advanced study, treating them both as parts of a united endeavor. There are always stresses between the claims of one undertaking and the other, but in its resolute and insistent concern for both, the best American university tradition has a value that is almost unique in the world.

A second great advantage of our university pattern is that it permits escape from the cabin of narrow dedication to a single established discipline. We cannot claim that most university people do in fact make the most of their opportunities to work with colleagues who use other skills and ways of thought. But in most of our major universities at least the opportunities exist for the natural scientists, the social scientists, and the humanists to talk to one another, and although many departments and individuals sternly resist "contamination" from exposure to the ideas of those outside their traditional intellectual borders, there are others whose horizons are continuously widened by living in the presence of many kinds of learning. As the government has a growing interest in all forms of higher learning (even though it is, correctly, relatively cautious in its relations to social and humane studies) it shares with the universities the good

and important belief that no branch of learning should habitually claim to do better alone.

The third great asset of the American research university is its variety. No two universities are the same. Among them they have made room for both pure and applied science, for both the traditional and the novel, for both cooperation with and criticism of the government, for both the long view and the immediate issue, for research and for teaching, for technology and for art.*

In the last ten years an unusual confluence of events has tested the resilience of our major universities with a severity not matched since the Great Depression. A time of social and political trouble, magnified though not created by the Vietnam War, has been followed by a time of economic trouble, intensified though not created by a federal government that has sometimes failed to understand the national value of basic scientific research and advanced academic training. Persistent inflation intensified by the oil crisis has hit hard at budgets already under stress. And perhaps more durable and deep-seated than any of these events has been the impact of a belated recognition that demographic change, bringing an end to annual increases in the number of our college-age youth, has drastically restricted the number of openings in prospect for those aiming for academic careers. After fifteen or twenty years in which there seemed to be a

*In speaking thus of the world of the major research universities, we must not exclude or depreciate the importance of other institutions that have made extraordinary contributions. To cite only two: in science, the Carnegie Institution of Washington and, among research libraries, the New York Public Library (whose research collection is mainly a private achievement) are national assets whose claims to national support are closely parallel to those we make for university scholars and laboratories. Such independent institutions constitute another fruitful element in our higher learning. They too have a claim on national support.

wide horizon of academic opportunity for almost every Ph.D., we are entering a decade as restricted, in quantitative terms, as any since the Depression.

In these hard years, many in the world of education have been ready to sing one or another of two songs: that the great universities (especially the private universities) are doomed in any event, or that their one salvation lies in a vast rescue operation by the federal government.

We hold neither view. The major research universities of the country will not die. They have come through periods of anxiety and austerity before now, and already most of them have moved energetically to meet the economic crisis of the last few years. The political turmoil and social anguish of the late sixties have faded away, and forecasts of permanent damage from that turmoil appear to have been much exaggerated. A cruel price in suffering and distraction from learning was paid by students and faculties in those years, but the experience of World War II suggests the possibility of recovery from even larger disruptions of ordinary academic life.

Nor do we believe that the major research universities can be saved only by the federal government. In defending their basic financial integrity, both public and private universities must look to *all* their many traditional sources of support, and they are doing so. It would be a grave mistake for them to lose the autonomy and diversity that they have gained over a century. Their growth has reflected the choices of large-scale private philanthropy, the commitments of state governments, the preferences of tuition-payers, and the affections of alumni, as well as more recent federal support.

The research universities thus come to the federal

government not for their own survival, but to make it plain that central parts of their natural work have the following two characteristics:

1. They are of critical importance not just to the university world but to the quality and even the security of American life.

2. Outside the federal government there is no adequate source of supplemental support at the level they need today.

In later sections of this report we argue that these twin propositions now hold in at least four fields: basic scientific research, graduate education, research libraries, and international studies. Although leaving the detailed argument to those later sections, we would make it plain here that what is operating to create these critical needs for federal action is a set of forces at once historical, technical, and economic.

Some of these forces we have glimpsed already. In this age of continuing explosive expansion of the range of what we need to know, the costs of experimental equipment, of data collection, and of library service have also exploded far beyond the resources that have ever been available to major research universities from any source other than the federal government. In international studies, for example, it takes years of intense effort to produce even a junior specialist on China or Africa, and the total costs of the necessary time and materials for training, travel, and research make training in this field probably more expensive than that in any other in all the humanities and social sciences. No private source can meet such costs, and yet a strong supply of qualified specialists, in and out of government, is quite literally

indispensable to the nation's safety in the increasingly interdependent world of the future.

In the basic sciences the need for federal action first became fully evident in World War II, and in that area the ups and downs of federal support have been increasingly decisive ever since. In the other three fields we have mentioned the recognition of a critical federal role has come more recently and less plainly. Indeed in one case, that of research libraries, adequate recognition has not yet been given, and in consequence serious damage has already been suffered by what are in fact priceless assets of society as a whole.

So let us here take the case of basic scientific research as a brief model for our general argument. The most authoritative analyses of all forms of support for basic research are those of the National Science Board. Its description of the history and justifications of the dominant role of the federal government is definitive: "The Federal Government assumed prime responsibility for support of basic research after World War II. This policy recognized the decisive role played by scientific knowledge in the war effort, and sought to strengthen the Nation's basic research capability for peacetime pursuits. Over the past 30 years, the policy has come to be predicated on the broad and varied role of basic research in advancing the country's defense, economy, health, and technology, as well as upon its general cultural value, in education and in the intellectual life of the Nation."[2]

Under these guiding principles, federal support for basic scientific research, of all sorts in all institutions, had by 1968 reached an annual level of $2.3 billion and amounted to about 70 percent of all such support, with

the rest of the money coming from industry, from colleges and universities themselves, and from other nonprofit institutions. It is no coincidence that in that same period American basic science became easily first in the world. Moreover, it was the habit, from World War II to the late sixties, for both the government and the scientific world to take public and justified pride in their enormously productive partnership.

Unfortunately, since 1968 the situation has been different. The simplest and most powerful change is in the decline of federal support for basic research. Inflation and other forces reduced support from all sources at one time or another in this period, but support from the federal government declined first and most, while that from colleges and universities declined last and least. By 1976 federal support for basic research, measured in constant dollars, had declined by almost 15 percent, although there was an encouraging upturn in fiscal 1977 which is projected to continue into fiscal 1978.

Nor has the damage been merely economic. In constantly increasing measure the notion of a partnership for common basic purposes has been replaced, in many parts of the government, by the concept of a mere purchase of services. This is partly the consequence of tight budgets, which always lead to hard bargaining. It is also partly the consequence of an excessive effort to connect research to quick results. But in a deeper sense it reflects a misconception of the elemental character both of basic research in universities and of universities themselves. What has happened, especially in the critically important Office of Management and Budget, is that the concepts of the commercial market have been applied to a world they do

not fit. As one striking consequence, OMB has adopted a general policy of opposition to federal grants for graduate-student support, and the number of doctoral fellowships funded by grants, which reached 50,000 in 1968, has fallen by more than 70 percent.

The authoritative final report of the National Board of Graduate Education explains the thinking behind this result. Describing the attitude of OMB, it says: "The dominant view expressed by this key agency in recent years is that graduate education is a form of investment in human capital, with the benefits primarily private, not social. Consequently... there is little justification for federal subsidy in the form of fellowships; instead, the student-investor should pay for his/her own education, borrowing if necessary or working as a research assistant."[3]

This view runs flatly against the historic practice of the best graduate schools with their best students and flatly against the historic distinction between commerce as a paying proposition and scientific work of the first rank as an essentially nonprofit activity. And this view of graduate education has its parallel in the view of university research: "With regard to the support of research, universities are viewed as one among many types of competing institutions that can provide useful information to mission-oriented federal agencies. Research results are a commodity that the agencies can purchase as necessary from universities or any other competent supplier."[4]

It would be hard to misunderstand the matter more thoroughly. Certainly some great science comes from commercial laboratories and some university research

makes money, but the driving and decisive truth is that basic scientific research as a whole is *not* profitable in the ordinary commercial sense. Neither basic research nor the university that is its principal American home can flourish if subjected to the tests and values of the commercial marketplace. Nor can the long-run needs and interests of the federal government itself be met merely by purchase of mission-oriented "research results." This is not what basic research is, or how it works.

Fortunately the true view of the matter is neither strange nor hard to articulate. Nor is it new. No better statement of the appropriate federal posture has ever been made than the following, which comes from a report submitted to, and warmly welcomed by, President Dwight D. Eisenhower in 1958. Here is what the President's Science Advisory Committee then argued:

> This year's Federal money will pay for about one half of all the scientific research, engineering, and development carried out in the United States.... It is apparent from the size of this effort that the Government exerts a powerful shaping influence on all U.S. science and technology. Not only the nation's security but its long-term health and economic welfare, the excellence of its scientific life, and the quality of American higher education are now fatefully bound up with the care and thoughtfulness with which the Government supports research. If this support is halting and erratic, if it emphasizes mechanism and "hardware" to the neglect of fundamental understanding, if it lavishes money on a few popular fields and starves others of importance, if it fails to encourage exceptional men and exceptional programs, the net result could be an impoverished science and a second-rate technology.
>
> One of the clearest lessons to emerge from the history

of science is that various scientific disciplines—seemingly unrelated—have a way of stimulating and fructifying each other in an unexpected manner. This complex back-and-forth interplay is the life and soul of science and technology—there can never be too much of it. The most impractical thing that can be done in designing and directing programs of scientific research is to worry overmuch about how "practical" they are. The secrets and treasures of Nature are hidden in the most obscure and unexpected places. It is clear, therefore, that the strongest scientific program is the program with the greatest breadth and scope. It is impossible to predict from which quarter the next scientific advance will come; but we can try to make sure that the Nation has able people at work across the whole scientific frontier.[3]

This account of the matter does not speak of narrow specific needs or of payment for services rendered. It does not make the mistake (which the universities themselves have sometimes made) of arguing that all current hard problems can be "solved" by a quick research "fix." It speaks of the support of science in all its range and quality because of what that range and quality can mean in ways that are as sure, in general, as they are unpredictable in particular cases. The paradox of basic research is the paradox of the research university itself: it will never be a money-making proposition, but our society will always be poorer, in every way, where it is weak.

Adequate, open, sustained support for basic research is essential, and so is one thing more: a renewed emphasis on quality. This principle applies to all four of the areas of the universities' work that we consider in this report.

It is sometimes argued that the federal government is

ill-fitted to demand excellence in return for support, and in recent years there has been some tendency in Washington to emphasize quantity at the expense of quality. But the full record, running back to 1941, is evidence that there is no inherent conflict between the federal dollar and truly distinguished achievement. The work of tens of winners of Nobel Prizes was supported by federal funds over long periods *before* the winners were honored, and there are laboratories under direct federal management that are great. There is also the plain record of a number of agencies, and particularly of the National Science Foundation, that where political authorities do emphasize quality, the agencies know how to respond.

The principal instrument for achieving high quality, in all of the fields discussed in this report, is a simple one: it is reliance on the judgment of those best placed to judge. In basic research that will usually mean a jury of an investigator's scientific peers, although it is important not to let the peer-review process wither into mutual backscratching. In the distribution of support of graduate training for a limited number of college graduates, it is today's researchers and scholars who are best equipped to select the winners, through a genuinely competitive process. After that it is the accepted candidates, and no one else, who should have the right to decide where to go for their advanced training. The best available judges of the quality of graduate education are the graduate students themselves, and the country is not so large nor its communications system so weak that they are not able to make their own well-informed choices.

Similarly, we can say that as and when the federal government addresses itself adequately to the pressing

national need for help in making our great libraries equal to the test of the next generation, and as and when it properly recognizes the national need for sustained support of advanced international studies, it will be able to find judges, and also mechanisms, to help it put its money where it will support what gives most promise of excellence.

The major research universities themselves, we believe, would be greatly reinforced by federal action in the general spirit outlined in this overview and more explicitly defined in the sections of our report that follow. We do not apologize for this predicted result, and indeed we believe that the national interest in first-class research and scholarship implies a national interest in the health of the institutions that are their main source.

In the section on basic scientific research we argue for a broader approach by the federal government to all aspects of the academic sciences. We believe that federal funding patterns must reflect the nature of the long-term commitment that institutions make when they engage in basic research. To our mind, the annual funding arrangements currently in force create severe disruptions. We offer several alternatives that would assure greater continuity for the taxing search for new knowledge. The basic-science section also recommends that the sensitive and complex issues associated with overhead payments to universities be reexamined and treated differently by the funding agencies. We recommend that effective opportunities for dialogue between research universities and government officials responsible for research planning and funding be created, and that the Office of Science and Technology and the President's Science

Advisor consider ways to encourage such dialogue. We also call for significant increases in the number of individual grants to scientists at all levels—graduate students, junior faculty members, and senior professors.

The call for more fellowships is echoed in the section dealing with graduate-student support. We also argue there that eligibility for merit awards should be broadened to include graduate students pursuing advanced degrees in the social sciences and the humanities. This section also calls special attention to the need to increase the participation of minority students in graduate studies to ensure that future academics come from all groups in our society. We recommend that federal policy on other student-support grants and on existing loan programs be reexamined.

The third section deals with the condition and needs of research libraries and provides a broad analysis of the problems these important institutions now face. We recommend in that essay that the federal government pay urgent attention to the needs of research libraries and that the necessary funding be provided for part C of Title II of the Higher Education Act of 1965 as amended in 1976, which authorizes federal grants for the country's leading research libraries. We also call on the Library of Congress to take a leadership role in formulating and implementing policies that would lead to the more efficient management and preservation of the significant collections housed in research libraries.

Our report on international studies addresses the need for federal government support of scholarly activities concerned with foreign areas. It points out that the rationale for federal involvement is the importance of

maintaining and further developing our national competence in international affairs. While we recognize that universities must continue to bear the brunt of the costs of international studies, we believe that two types of federal assistance are required. The first is direct subvention to between thirty-five and fifty university centers of international affairs selected on the basis of merit by nationwide competition. The second consists of programs that include pre- and postdoctoral fellowships for American scholars, as well as activities aimed at improving international studies in schools by the development of lively teaching materials and by providing fellowships for schoolteachers.

But we must emphasize once more that while we believe there is a deep national interest in the well-being of the major research universities of this country, we do not urge the adoption of our four sets of recommendations on anyone who is not persuaded, in each case, that the programs themselves are in the nation's service. We have considered and rejected the proposals of some distinguished Americans that direct institutional grants be made to a limited number of "national" universities. Aside from the difficulties of choice—where is the jury of peers for the task?—we perceive in any such program grave long-run dangers, both to the universities themselves and to the integrity of federal decision-making.

The universities are and should be autonomous. Their members will, and should, do things that irritate the temporary holders of political power. The means of reprisal should never be easily at hand. Ours is not a society in which small groups with a single perspective will be happily trusted to make massive direct institu-

tional grants to the jostling and ever-changing set of universities that someone thinks are at the top. There is no solid ground for a decision that, among the dozens that see themselves as leaders, some and not others should be baptized "national."

The competitive method—or set of methods—is better. In this respect the analogy to the open markets of commercial competition is entirely right. As long as the test of excellence is applied, those who think they are leaders will have only themselves to blame if they do not earn a share in truly competitive programs, while at the same time the door will remain open to those institutions with newly achieved excellence to offer.

What is essential is to turn away from mistrust and back to the concept of partnership, away from misplaced short-run standards and back to the idea of excellence, away from profit-and-loss accounting and back to the rousing conviction that there can be no good and free society, still less a great one, where the university's not-for-profit science and scholarship do not flourish.

NOTES

1. National Science Board, *Science Indicators 1974* (Washington, D.C.: National Science Foundation, 1975). The figures for universities do not include another, highly important 7 percent spent in Federally Funded Research and Development Centers (FFRDC), administered by universities and dependent on the university connection for much of their excellence.

2. Ibid

3. National Board of Graduate Education, *Outlook and Opportunities for Graduate Education* (Washington, D.C.: 1975), p. 77.

4. Ibid.

5. *Strengthening American Science*, A Report of the President's Science Advisory Committee (Washington, D.C.: 1958), pp. 1-2.

# The Critical Role of Basic Scientific Research

After World War II, federal support of basic research lifted the United States to a position of acknowledged leadership in science throughout the world. Since 1968, however, there have been unmistakable signs that our scientific effort has begun to lag. Federal support has steadily declined, both in real dollars and as a percentage of GNP, and other nations, such as the Soviet Union and West Germany, have come to surpass us in the share of national income devoted to scientific research. The decline has been particularly severe in the support given equipment and facilities, causing a deterioration that is beginning to affect the quality and innovativeness of research. Investigators are also hampered by uncertainty and instability in federal funding, by increasingly complex regulations, by growing administrative burdens, and by pressures that seem to threaten the principle of awarding support on the basis of scientific merit. Financial stringency in the universities has limited the possibilities for promotion of younger scientists, thus driv-

ing them into less stimulating and creative research environments.

The vitality of scientific research is a matter of critical importance to the nation. Without new scientific knowledge, we will be unable to solve many of our pressing national and international problems in such areas as agriculture, energy, and the environment. The development of science is also indispensable to maintaining a sophisticated system of defense and to preserving the strength of a high-wage economy that depends on advanced technology to remain competitive. Finally, continued research in science is essential to discovering the causes and improving the treatment of major diseases.

There are no shortcuts to the acquisition and maintenance of scientific leadership. Although the momentum of past scientific efforts may temporarily obscure the effects of inadequate support, we cannot reduce our commitment to scientific research for any significant period without producing lasting effects on the vigor and effectiveness of science in this country. Although we must make a determined effort to apply existing knowledge to specific needs, we must also continue a strenuous research program to discover new knowledge if we are to address many of our existing national problems and prepare ourselves for issues that are as yet unforeseen.

The recent decline in the strength of our research effort results in part from a widespread lack of clarity about the nature of scientific development and the ingredients that are critical to its pursuit. Responsible public officials and civic leaders need the fullest possible information on these issues in order to assess the

adequacy of our present programs for science. The institutions that carry out research have a corresponding obligation to provide such information, in order to identify weaknesses in our science program and to justify the large expenditures of public funds that are required to increase our understanding of nature. In this section of our report we therefore address these issues and set forth positive recommendations to reverse the decline in our national research effort and to assure its continued vitality.

## The History of American Scientific Leadership

Ten months before the end of World War II, President Franklin D. Roosevelt asked his chief science adviser, Vannevar Bush, how science might "be used in the days of peace ahead for the improvement of the national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living." Bush's answer was embodied in a remarkable document, *Science, The Endless Frontier,* which advanced the then radical proposition that private funds would no longer be adequate for conducting scientific research on a scale appropriate to the needs of the United States in the middle of the twentieth century.[1]

Although Congress had previously appropriated very little for scientific research (with most of what was appropriated going to agriculture), Bush proposed the creation of a new federal agency to support basic science. With some modifications, the agency he described was created by Congress in 1950 and named the National Science Foundation (NSF). Bush had visualized that the

new agency would channel most of its funds into the research laboratories of colleges and universities. "These institutions (together with nonprofit research institutes)," Bush wrote, "provide the environment which is most conducive to the creation of new scientific knowledge and least under pressure for immediate, tangible results.... If [they] are to meet the rapidly increasing demands of industry and Government for new scientific knowledge, their basic research should be strengthened by use of public funds."

Guided in large part by Bush's vision, the federal government became an increasingly generous patron of science. Before the recent erosion in federal support, the nation's academic institutions shared handsomely in the benefits of this policy. Whereas in 1940 colleges and universities had available for scientific research only $31 million, from all sources,[2] they received nearly $2.3 billion in federal funds alone in 1975.[3] Added to this amount were funds from industry ($100 million), funds from foundations and other nonprofit institutions ($250 million), and the universities' own funds ($750 million, of which roughly half was provided by state and local governments). Thus in 1975 the total value of funds available to colleges and universities for scientific research was $3.4 billion.[4]

Even allowing for a fourfold rise in the price level between 1940 and 1975, this is a more than twenty-five-fold increase in resources for academic research. Similarly, the nation's total expenditure for scientific research in 1975, $35.2 billion, was again a twenty-five-fold increase over the 1940 figure. But whereas the federal government had provided only 20 percent of the 1940

total, it contributed 53 percent ($18.6 billion) in 1975.[5] Only a quarter of a century after the birth of the National Science Foundation, the results were already impressive. Some of the highlights are these:

> The United States was the leading producer of the scientific literature published in the period 1965-1973, except in the fields of mathematics and chemistry, in which the Soviet Union was first.
>
> United States research was cited with a frequency that led or equaled that of all other countries in the 1973 literature, ranking highest in chemistry and physics.
>
> Scientists from the United States have received 91 of the 183 Nobel Prizes awarded since 1943, although before the awards were suspended at the outbreak of World War II American scientists had received only 15 Nobel Prizes out of 128.
>
> The United States produced 65 percent of 492 major technological innovations in the period 1953-1973. (Great Britain was second with 17 percent; Japan was third.)[6]
>
> The United States has been consistently selling to other nations four to five times more technical expertise than it has purchased abroad.
>
> The United States has a large favorable balance of trade in commodities produced by research-intensive industries (such as the computer, well-drilling equipment, aircraft, and chemical industries).

Despite these indicies of success, any federal expenditure of the magnitude represented by the budget for scientific research warrants close examination. Where and for what purposes is the money best spent? Are the recipient institutions the ones best qualified for spending federal funds efficiently? Are the existing procedures and

patterns of federal support working well? And, perhaps most important of all, how can the public know whether it is getting its money's worth?

### The Essential Contribution of Basic Research

Sixteen percent of the federal budget for all scientific research goes to the support of basic research. This share came to $3.2 billion in 1976, of which $1.8 billion, more than half, was spent in the nation's colleges and universities.* However, "the general public," as Vannevar Bush wrote in 1945, "is still far from a true understanding of the nature of basic research and of the fundamental difference between science and technology."[7] The difference should perhaps be stated here. Quite simply, basic research is the effort of scientists to understand the fundamental nature of things, without the deliberate intention of solving a practical problem to achieve specific utilitarian ends. Technology uses the fundamental knowledge gained through basic research to create useful machines, materials, and devices.

Any knowledge that enlarges our understanding of nature is of intrinsic value. Nevertheless, as America is a pragmatic country, it is only natural for the public to question the wisdom of expending the taxpayer's dollar to pay for research that is not deliberately aimed at finding solutions to important social problems. These

*Of the nation's total scientific-research expenditure of $38 billion in 1976, the portion devoted to basic research was $4.8 billion, or about 13 percent. Of the $4.8 billion, the federal government provided 67 percent; industry, 15 percent; colleges and universities, 11 percent; and other nonprofit institutions, 6 percent *(National Patterns of R&D Resources, 1953-1976)*.

doubts are understandable and deserve a thoughtful answer.

In fact, there are strong reasons for supporting a vigorous effort of basic research. When scientists seek answers to pressing, practical problems, they make progress by drawing upon the existing body of fundamental knowledge. When our stock of basic knowledge is inadequate, as it is, for example, in the program to conquer cancer, efforts to find a solution will be stymied until the needed knowledge is obtained. Experience demonstrates that the supply of knowledge will be enlarged most effectively by researchers who are allowed to pursue their own scientific interests. This is so for two reasons. First, the most creative minds seem to function most effectively when they are free to follow their own internal logic and intellectual interests. And second, it is impossible to perceive in advance what basic knowledge will prove important to the solution of a particular practical problem. When Alexander Fleming became curious about the inhibition of bacterial growth around a mold that contaminated his petri dish, neither he nor anyone else could imagine that his inquiries would make possible the development of penicillin. Countless similar examples can be cited. If we wait until its direct relevance to a practical problem is defined and only then begin to search for the required basic knowledge, our progress in the advancement of all science will be immeasurably delayed.

Several recent studies help to demonstrate the vital link that exists between basic research and useful inventions and applications. In 1974, the National Science Board sought to determine whether basic research con-

ducted in universities played any role in inventions of major importance subsequently developed by industry.[7] The board identified 179 major technological advances made between 1950 and 1973 and determined that university research was increasingly cited in the basic patents, while citations to industrial research declined steeply.*

Another study traces the basic research underlying advances in biomedical science.[9] The authors first identified the ten most important advances in cardiovascular and pulmonary medicine and surgery in the last thirty years. The list included open-heart surgery, artery repair, the use of drugs for treating hypertension, cardiac resuscitation, chemotherapy and antibiotics, and immunization against poliomyelitis. The authors also characterized the "essential bodies of knowledge" that made the ten advances possible. They then identified the published research reports that were "particularly important to the development of one or more" of those areas of knowledge. They divided these scientific reports into those that were clinically oriented, addressing immediate practical problems of diagnosis and treatment, and those whose authors sought knowledge for its own sake, without a stated interest in its application, or concerned themselves with the "basic mechanisms of disease" rather than with clinical problems. The group

*The technological areas covered by the study included chemicals, electronic components, communication devices, photographic and optical equipment, computers, metals and alloys, pharmaceuticals, and transportation systems. Whereas in the first half of the twenty-four-year period covered by the study university work accounted for only 28 percent of the research citations in the patents, it accounted for 54 percent in the second half. Citations of industrial research declined from 57 percent to 15 percent in the second half of the period.

of authors engaged in basic research, they found, contributed 61 percent of the new knowledge that made the major medical advances possible. They therefore concluded that "basic research... pays off in terms of key discoveries almost twice as handsomely as other types of research and development combined." They recommended that "a generous portion of the nation's biomedical research dollars... be used to identify and then to provide long-term support for creative scientists whose main goal is to learn how living organisms function, without regard to the immediate relation of their research to specific human diseases."

Even more extensive economic studies of the return on basic research have been made by agricultural economists. They have concluded that research has yielded a higher rate of return than any other agricultural investment, and that the return on basic research has been the greatest of all.

### Can Basic Research Be Deferred?

In times of economic stringency it is normal for government agencies and the Congress to review all expenditures particularly carefully. It may seem reasonable to ask, Can't we reduce the funds for basic research until the financial picture brightens, making up for the reduction then? In fact, isn't it possible that we have a sufficient deposit of unused knowledge right now and that we would do better to devote our limited resources to mining it for human benefit rather than casting about for still more knowledge?

It is true, of course, that in an emergency almost

anything may have to be deferred. During World War II, most basic research was suspended while scientists developed radar and sonar, built the atomic bomb, and performed countless other urgent tasks. This policy was a necessity, but even so, we could maintain it for only a few years. Cutbacks in basic research and in the training of new researchers could not have continued much longer without serious long-term consequences.

In more normal times, continuity of support for basic research is essential for the economical use of resources as well as for a continued flow of ideas. When basic research is interrupted, expensive equipment is underutilized, trained research groups are disbanded, and, perhaps most serious of all, able students become discouraged about choosing careers in science. Thus, even a brief reduction in funding for basic research may have long-lasting effects that impede the progress of science. Conversely, crash programs of scientific research on the massive scale of those mounted during the war are relatively inefficient and can be justified only by dire national emergency. They substitute intensive parallel efforts for orderly sequential discovery, and they buy time at a very high price.

The suggestion that we have enough basic knowledge for the time being also goes against the facts of the matter. Our stock of basic knowledge rarely contains everything necessary to solve a complex practical problem. The knowledge needed is almost always an unpredictable mixture of old and new basic science. Humanity is faced with hundreds of problems whose solution is likely to require basic knowledge we do not yet have: the control of cardiovascular degeneration and

mental illness, the prevention of cancer, the practical use of energy from the sun, the increase of agricultural production with less reliance on synthetic fertilizers, the development of biological methods for the control of insects and other pests, the prediction of earthquakes, the mitigation of the environmental effects of industrial growth, the control of severe storms, the forecasting of climatic change, the better utilization of our increasingly limited resources of energy and materials, the more efficient management and use of large volumes of information, and so on and on. Moreover, the "practical" programs we are mounting today in energy production, environmental regulation, and the cure of cancer, for example, are proving much more costly than they would be if we possessed a better stock of fundamental knowledge on which to base our efforts.

The lack of adequate basic knowledge also leaves us vulnerable to dangers arising from unsuspected quarters. Who would have guessed, for example, that the supposedly inert gases from aerosol containers might pose a grave threat to the ozone layer and thus to the earth's climate? The hazard was detected by scientists who had made a career of studying the basic chemistry of the upper atmosphere. Who knows what other seemingly innocuous product or activity is doing unsuspected harm to ourselves or to the unimaginably complex biosphere? Because all nature is an intricate whole, it is hazardous to try to limit research to those areas that seem most relevant to national needs at a particular moment and to skimp on other areas. Atmospheric chemistry was considered a remote and esoteric field of research until a scientist suggested that the proposed supersonic trans-

port aircraft might, through its exhaust, cause damage to the stratosphere. The classical subject of spectroscopy suddenly burgeoned when the invention of the laser, based on insights first supplied by Einstein in 1905, unexpectedly revived the whole field and created a frantic demand for specialists. A policy of targeting research only on apparently "useful" areas will only leave us unprepared for unexpected future problems and will increase the time and money required to solve these problems when they are identified.

## Institutions for Basic Research

Basic scientific research is chiefly carried out by private companies, by government agencies, and by universities. Each sort of institution makes a distinct contribution to the nation's scientific effort. Each has particular strengths and limitations that must be recognized in mounting an overall program of basic research.

Some excellent basic work has been done in industrial laboratories. Nevertheless, the amount of this work that private corporations can be expected to carry out is limited. Not only is there no way of knowing whether or when basic research will result in practical applications within the firm's field of interest, but there is also a good chance that the economic benefits of the research will be captured by a competitive firm or by another industry. This is why only a few of the very largest corporations can support fundamental science on a significant scale.

Several government agencies carry on extensive basic research in their own laboratories. Government expenditures for intramural work of this kind amounted to

approximately $600 million in 1975, representing about a fifth of all federal support for basic science. Some of this research has been outstanding, such as that carried out by the National Institutes of Health. But the scope of intramural research is generally subject to prescribed limits. For example, research in laboratories operated by the National Aeronautics and Space Administration, the Department of Defense, the Department of Interior, and the Department of Commerce tends to be "mission-oriented," and such basic research as these laboratories do must be justified by a demonstrated relevance to the purposes of the agency.

In addition to the "in house" government laboratories, federal agencies maintain a number of other facilities dedicated almost exclusively to basic research. These are the national laboratories administered either by individual universities or by university consortia. Examples are the Fermi National Accelerator Laboratory in Batavia, Illinois, which houses the world's largest particle accelerator; the National Radio Astronomy Observatory in Greenbank, West Virginia; the National Astronomy and Ionosphere Center in Arecibo, Puerto Rico; and the Kitt Peak National Observatory and the National Center for Atmospheric Research in Boulder, Colorado. These laboratories, which are known collectively as Federally Funded Research and Development Centers (FFRDCs), maintain extremely large and expensive facilities that are too costly for any single university to acquire and operate. They make an important contribution to the nation's scientific effort, but as a group they cover only a relatively small part of the spectrum of basic science. All of them depend on universities as a source of permanent

research personnel. Moreover, many depend heavily on the work of visiting scientists from universities. For example, although more than 75 percent of the federal funds invested in high-energy physics go to national centers, more than 80 percent of the publications in the field are by university-based authors (many of whom, of course, also use the national facilities). Without the support of "user groups" in universities, the national facilities would be relatively unproductive.

A recent study of the sources of research reports prepared in the United States in thirteen fields shows that 75 percent of the reports are produced by scientists and engineers in academic institutions.[10] There are good reasons why universities play this predominant role. These institutions provide the atmosphere of intellectual freedom that scientists consider vital to carrying out fundamental research of the highest quality. Universities also encourage a close and continuing association between experienced investigators and able young students. This association provides the best possible environment for training new generations of scientists, who need the tutelage of the ablest, most experienced senior investigators. But the presence of students also provides an essential stimulus for established scientists. The combination of younger and older minds offers an ideal setting for encouraging the reexamination of old ideas and the formulation of new questions, new hypotheses, and new ways of looking at data. It is for this reason that the university environment has consistently attracted scientists of great distinction; almost all the American Nobel Prize winners in science performed their research at universities. Scientists of this quality draw students

who become the next generation of intellectual leaders. It is all too easy to imagine the unfortunate effects on the progress of science in this country that would have resulted if these scientists had not chosen to teach.

The suggestion is sometimes made that the government would get a higher return on its basic-research dollar if more basic science were done in separate institutes, such as the FFRDCs, rather that in the universities. The usual arguments are that the investigators working in institutes are not distracted by teaching and other academic chores and that separate institutes, not engaged in teaching, can be supported without simultaneously increasing the output of new scientists beyond the capacity of the country to absorb. It is pointed out that France, Germany, and the Soviet Union all conduct much of their basic research in institutes isolated in whole or in part from their university systems.

There is little in the record to indicate that a system of institutes separated from universities will be notably more productive as a source of basic knowledge. Indeed, there is considerable evidence that even the most prestigious institutes isolated from an academic environment frequently show the inexorable effects of aging. The constant challenge of explaining science to the fresh minds of students is an important stimulus to new research ideas, forcing scientists to synthesize and condense what they know in ways that can produce new means of looking at their fields. For these reasons, both France and the Soviet Union seem to be acknowledging the drawbacks of separating teaching and research and are beginning to modify their systems accordingly. Moreover, the European institutes have never been quite

as isolated from universities as they are often portrayed. For example, institute scientists have long held posts in neighboring universities, and this practice is increasing. In the USSR, many institutes have also taken steps to include university students in their activities.

The argument that the present system may be producing a surplus of Ph.D.'s in science is also vulnerable. Recent studies show that scientists are far more professionally mobile than was once believed and that good research training under a first-rate teacher qualifies the graduate student for a wide variety of career possibilities. Unemployment among academically trained scientists has at no time approached the level of unemployment in the general economy, even though not every scientist may find exactly the position preferred.

Government facilities and industrial laboratories will continue to have important roles in our national scientific effort. At the same time, experience shows us that a setting in which graduate students and established scientists interact offers the most efficient and productive environment for most forms of basic research, while simultaneously allowing the ablest students to acquire their scientific training under the tutelege of the most distinguished scientists. There is every reason to believe that the present allocation of basic research will continue to yield the results that have made American science preeminent during the past three decades.

### Sources of Support for Basic Research

The federal government now finances almost 70 percent of the basic scientific research in the United States; it also

provides approximately 70 percent of the funds available to universities for this purpose—$1.8 billion in 1976. Since the fruits of research benefit the entire country, it seems appropriate in principle that the federal government assume this major share of the cost.

Universities do receive 30 percent of their funds for basic research from state governments, foundations, industry, and their own endowments, and this support offers diversity and flexibility that allow universities to pursue their research with a wide degree of freedom. Nevertheless, none of these sources could conceivably take the place of the federal government in supporting an adequate national program in basic science. Neither foundations nor private universities have anything like the necessary funds, nor is it likely that state legislatures will appropriate larger sums for this purpose than they already do.

## Current Federal Policies Toward Research

After its remarkable and unprecedented postwar increase, the nation's total expenditure for all scientific research, in constant dollars, dropped 7 percent from 1968 to 1974.[11] The reduction in federal support of this research was far more precipitous, dropping 20 percent from 1967 to 1974. The volume of federal funds allocated to basic research fell only slightly less sharply during the same period, about 13 percent; the share of federal funds for basic research that went to the nation's universities declined by almost 14 percent and remained at very nearly the same depressed level through 1975 and 1976.

These figures tell only part of the story. The drop in federal funds for university basic research was made more painful by the way in which the available funds were redistributed. The decline from previous maximum levels amounted to 20 percent in chemistry, 30 percent in physics and engineering, and more than 40 percent in astronomy. The life sciences fared somewhat better, with a decline of only 7 percent. The only significant increase was in the support for environmental sciences, which climbed by roughly 13 percent.

Fortunately, the decline in federal support of basic research seems to have halted. In the federal budget for fiscal 1977 (which began October 1, 1976), Congress approved substantial increases in obligations, averaging about 13 percent, for all basic research supported by major government departments and agencies. The actual disbursement of funds lags considerably behind the authorizations so that in 1977 federal support of basic research in colleges and universities has not increased in constant dollars. By 1978, however, the level of support is expected to rise by approximately 12 percent in current dollars, or perhaps by 6 percent in constant dollars.[12] Although this increase will be helpful, it will still make up less than half the decline in constant dollars between 1968 and 1974.

Critics may argue that the recent erosion of federal support has simply corrected an overambitious expansion in the 1960s. But this interpretation is belied by the experience of other countries. While our scientific-research expenditures have been steadily decreasing as a percentage of GNP, the outlays of our principal international competitors in science and technology, including

the Soviet Union and West Germany, have increased, and some of these countries have now surpassed us.*

## RESEARCH EQUIPMENT AND FACILITIES

Although the decline in federal support of research has been general, the most serious reduction has occurred in funds for new equipment and facilities and for upgrading existing plant. In 1971 it was estimated that $275 million was needed to remedy then-existing deficiencies in research equipment.[13] Federal funds available to universities for new research facilities plummeted in constant dollars from $168 million in 1966 to $34 million in 1974.[14] In the mid-sixties, the National Science Foundation and the National Institutes of Health allocated approximately 11 percent of their project grants for permanent laboratory equipment. Today, they are able to provide only about 5 percent for these purposes.[15] These declines in resources have coincided with rapid

*The U.S. percentage of GNP expended on all scientific research decreased from 3 percent in 1964 to 2.3 percent in 1975, while research expenditures in the Soviet Union climbed from 2.4 to 3.1 percent of GNP in the same period. In West Germany the increase was from 1.5 percent to 2.4 percent of GNP. The Japanese increased their research outlays from 1.3 percent of GNP in 1963 to 1.9 percent in 1975. The British research expenditure was stable at around 2.7 percent during the last half of the 1960s; more recent figures are not available. The French expenditure of between 1.8 and 2.2 percent has held fairly constant over the last decade *(Science Indicators 1974)*.

Because West Germany, Great Britain, France, and Japan support only small efforts in space technology and spend far less than the United States on weapon development (Japan spends hardly anything), it is likely that much larger percentages of their governmental budgets for research are devoted to basic research than is the case in this country. A 1973 analysis estimates that France, West Germany, and Japan were then devoting, respectively, 25 percent, 40 percent, and 60 percent of their government research budgets to the "advancement of science." Only about a fifth of the work classified by the United States as basic research can be regarded as meeting this same definition—that is, only 3 percent of the federal science-research budget (Organization for Economic Cooperation and Development, *Changing Priorities for Government R&D* [July 1973], quoted in *Science Indicators 1974)*.

increases in the sophistication and cost of experimental apparatus. Because scientists find it difficult to obtain funds for equipment, they tend to plan more conservatively and to be less innovative in shaping proposals in order to make do with existing instrumentation and facilities.

## ADMINISTRATION AND REGULATION OF RESEARCH

The constriction in federal funds for academic science has been paralleled by an increase in the amount of time investigators must devote to finding support. Federal support is now being divided into smaller and smaller grants so that scientists undertaking large projects must prepare multiple proposals. Federal agency regulations require specific approval by government officials for increasingly minor deviations from increasingly detailed project budgets, thus causing more delay and paperwork. Agency officers intent on conserving funds demand stricter and more detailed records of the use of research money and the expenditure of investigators' time. It is estimated that senior investigators now devote up to 20 percent of their time to the process of seeking and justifying research funds.

The paperwork required by federal agencies also absorbs large amounts of administrative staff time. Virtually all federal assistance is specifically designated either for scientific research or for student support. The funds must be used in the manner prescribed, and the agencies provide little or nothing to offset the administrative costs of complying with such federal regulations as equal-pay requirements, occupational-safety rules, or regulations governing students' records. Although the

burdens of compliance have fallen principally on administrative staff, federal regulations have also eaten heavily into the time of professors. At one university, for example, recent estimates suggest that paperwork and meetings associated with federal regulations consume over 60,000 hours of faculty time in an academic year.

## ALLOCATION OF RESEARCH FUNDS

There is an inevitable risk that federal funding agencies will be sensitive to political considerations in distributing funds. Strong social pressures have arisen to emphasize immediate, visible problems and to target research funds for work on these issues. Allocating funds in this way can be justified when the available basic knowledge is sufficient. Then the government can act to accelerate the application of that knowledge to the solution of a particular problem. But when the fundamental knowledge needed to solve the problem has not yet been found, targeting of funds can waste resources and actually impede progress toward the desired goal. We believe that there is now too much targeting of federal research funds and that a broad review of the principles and practices of targeting research is advisable.

Government officials also encounter obvious pressures to allocate grants in such a way as to provide at least some benefits to a large number of institutions throughout the country, avoiding the appearance of concentrating funds in favored institutions in particular geographic areas. The danger, of course, is that these pressures will lead to awarding funds to investigators less qualified to carry out the research involved.

To achieve the greatest progress in science and make

optimum use of the taxpayer's dollar, support must be channeled to those scientists best qualified to carry out the desired research, wherever they may be. Over the years, this country has developed a highly effective method of making these judgments. This method is the peer-review system, by which working scientists both inside and outside the government evaluate for the granting agencies the scientific merit of research proposals in their fields, judging the proposals for relevance, significance, and feasiblility.

Critics have sometimes alleged that the peer-review system may discriminate unfairly against less prestigious institutions or against younger scientists, women scientists, and those from minority groups. Although careful studies of peer review have failed to substantiate such assertions,[16] it is nevertheless appropriate that the system—like any system for judging merit—be carefully monitored. The principle of awarding financial support on the basis of demonstrable scientific merit is essential if the public is to gain the maximum benefit from the use of federal research funds.

## THE WEAKNESS OF FEDERAL FUNDING METHODS

The unpredictability of federal support in recent years has been almost as serious a problem as its overall decline. Changes in agency policy frequently lead to phasing out programs on short notice. Many federal agencies have been required to redefine their missions in narrower terms and to terminate research not demonstrably "relevant" to their work. As funds have become tighter, many agencies have shortened the duration of grants, thus requiring more frequent renewal and review.

At the same time, the interval between application and decision has increased so that an investigator has to plan further and further in advance in an atmosphere of greater and greater uncertainty. All of these difficulties are compounded when the Congress does not establish appropriations levels until several months into the new fiscal year, thus creating in agencies an uncertainty that is quickly passed along to grantees. Good research planning requires that investigators make hiring decisions and other commitments well in advance of starting work, but this can often become difficult under current conditions of funding.

## EFFECTS OF FEDERAL POLICIES ON SCIENTIFIC CAREERS

As college administrators well know, young people are acutely sensitive to factors bearing on their career choices. If highly capable college students perceive that the United States places a low priority on science, many of them will consider alternative careers. We cannot say what fraction of a nation's working population should be engaged in science and engineering, any more than we can say precisely what fraction of its GNP should be allocated to scientific research. What we can say is that the United States has fewer scientists and engineers in relation to its population than at least one other country, the Soviet Union, and may soon be overtaken by Japan.*

*It is estimated that in 1973 the Soviet Union had 930,000 scientists and technicians, or 37 per 10,000 population, as compared with this country's 523,000, or 25 per 10,000 population. In Japan, for which data are less complete, the number of scientists and engineers had already reached 198,000, or 19 per 10,000 population, in 1971 *(Science Indicators 1974)*. These comparisons must be taken with some caution because of possible differences in classification from country to country, but they are nonetheless suggestive.

Further, from 1969 to 1973, the Soviet Union increased its force of scientists and engineers by 33 percent. In West Germany in the same five-year period, the number of scientists and engineers increased by 44 percent, while in the United States the number *fell* by 6.3 percent.

The federal retrenchment that began in 1968, coupled with the other economic pressures on higher education, has tended to discourage many qualified young people from entering academic careers in science. The proportion of young faculty members (those holding doctorates for seven years or less) in the science and engineering departments of American universities declined from about 42 percent in 1968 to 28 percent in 1974. The proportion of faculty members with tenure has climbed from 47 to 63 percent, and the median age of faculties has increased. As we said earlier, the vitality of the scientific enterprise has always depended on a mix of ages, with a constant injection of new kinds of training and fresh ideas. The drying up of promotion opportunities threatens to drive many able young scientists out of universities into other fields or into other institutions less conducive to creative research.

### As Bacon Counseled...

Fundamental research, motivated primarily by the desire to understand the world around us in the deepest and broadest terms, is essential to the planning and fulfillment of the applied research and development of the future. This is hardly a new idea. Three and a half centuries ago Francis Bacon counseled that we must "from experience of every kind first endeavour to

discover true causes and axioms; and seek for experiments of Light, not for experiments of Fruit. For axioms, rightly discovered and established, supply practice with its instruments not one by one, but in clusters, and draw after them trains and troops of works." Without the new intellectual possibilities and conceptions turned up by basic research carried out in pursuit of fundamental knowledge, applied efforts are likely to lead us into expensive dead ends or cause us to blunder into the deployment of new technologies whose full consequences and implications we fail to understand until it is too late.

Our strength in basic research reached a peak in the middle-to-late sixties.[17] Thereafter, the relative position of the United States began to decline as we cut back on our research expenditures and as other nations continued to increase theirs. The effects of declining support have not become evident immediately, for the momentum of our prior research effort continues to produce important advances.* However, it is equally true that the effects of a sustained decline cannot quickly be corrected. As a result, any continuation of recent declines in federal support bodes ill for a nation that seeks to maintain a place of leadership in the world and to preserve a healthy economy based on advanced technology.

*The history of the work that won American scientists five Nobel Prizes in 1976 is instructive. D. Carleton Gajdusek began the work that earned him his share of the prize in medicine in the late 1950s. The co-winner of the prize, Baruch S. Blumberg, discovered the essential clue to his achievement in 1963. William N. Lipscomb, the chemistry award winner, conducted his prize-winning studies over a twenty-year period, beginning in the late 1940s. Although the particle discovery for which Burton Richter and Samuel C. C. Ting shared the award in physics was made in November 1974, much of the costly equipment they needed for their investigation had been built more than a decade earlier.

## Recommendations

### HUMAN-RESOURCES SUPPORT

Now that universities are no longer expanding their enrollments, it is not possible to justify expansion of academic research in terms of a growing need for teachers with advanced training in the sciences and engineering. Yet the character of modern science requires a critical size of effort if research is to be productive or even viable. An academic research system that is no longer growing also presents a serious problem of self-renewal. If we are merely to preserve the quality of academic research and the quality of the training received by students, we must provide for some controlled growth of academic research activity.

Because of declining student enrollments, high tenure ratios, and the limited number of faculty retirements, universities will not by themselves be able to provide over the next generation the minimum number of faculty positions and other career opportunities to ensure the flow of new young talent required to preserve the vitality of the scientific enterprise. As a result, government support is needed for a limited number of new positions that will provide rewarding careers for a small proportion of young scientists who are able enough to pass the necessary probationary hurdles. Such support over a fifteen-to-twenty-year period will help ensure a continuing influx of creative young scientists until universities can once again provide a normal number of new appointments as a result of rising enrollments and increased faculty retirements in the 1990s.

We believe that the following proposals outline a

pattern of career opportunities that will meet the needs of a healthy academic research system, as well as supplying the needs of government laboratories and private corporations.

*Graduate-student support.* As we discuss in the section of this report dealing with graduate education, no single category of support has declined more seriously than fellowships for graduate students. In the sciences in particular, this form of support has been partially replaced by teaching and research assistantships, which are generally tied to grants given senior investigators for specific research projects. Support of a student on a research assistantship in the first year of graduate work may prematurely lock the student into a particular line of investigation before he or she has had an opportunity to discover the range of research opportunities in a field.

**Recommendation 1**

**We here repeat the recommendation we made in the section of our report devoted to the needs of all graduate education and call for a substantial increase in the number of merit-based National Science Foundation Fellowships, from 500 new starts each year to 2,000.**

Since graduate students make important contributions to research while pursuing a degree, this increase in the number of grants will strengthen science immediately, while serving simultaneously to support the training of talented investigators for the future. The number of fellowships is not so great as to produce a glut of able scientists. Rather, it can be viewed as a prudent invest-

ment to ensure that the ablest young minds of our generation are not lost to science.

**Recommendation 2**
**Should the proposed increase in three-year fellowships be delayed, we urge the immediate annual provision of 1,500 new one-year fellowships, to cover students in their first year of graduate work.**

These 1,500 students, it is hoped, would be eligible for research and teaching assistantships during their second and subsequent years. But the availability of a fellowship, even for one year, reduces the risk of locking able graduate students prematurely into a particular line of research, as can happen if in their first year of graduate study they are dependent on assistantships tied to specific project grants.

*Awards for young scientists.* We see a need to extend professional opportunities for young scientists akin to the Alfred P. Sloan Fellowships and the recently established Alan T. Waterman Award of the National Science Foundation. The purpose of the proposed awards would be quite explicitly to encourage the growth of new fields in science and to encourage young scientists to undertake relatively high-risk research projects at an early stage of their careers.

**Recommendation 3**
**We propose that a selected group of unusually promising younger scientists be designated as "national scientists" and be awarded a high degree of support. We recommend that these scientists be permitted to choose the institutions in which they**

**wish to work, and, with the agreement of the institutions, be offered regular faculty appointments. We propose that the award cover salaries over a considerable period (at least five to seven years) and be renewable after a careful retrospective peer review. In addition to the stipend, the award should carry a substantial grant of unrestricted research money to permit exploration into new lines of research.**

*Senior career awards.* Awards to highly qualified senior scientists can have two desirable results. First, such grants provide support for research that is likely to be of significance. Second, if the awards are designed to assure funding over a considerable period of time, presently committed university funds are freed, thus opening up new faculty positions, which we consider essential to the continued health of the scientific enterprise.

**Recommendation 4**

**We propose the establishment of merit-based awards to established scientists of particular distinction. These awards would carry both a stipend and unrestricted research funds for an appreciable period.**

## IMPROVED FUNDING MECHANISMS

As federal funds have diminished, agencies have tried to stretch their resources by progressively shortening the duration of research grants. This procedure temporarily permitted a continuing level of activity with smaller appropriations, but its advantages have long since been exhausted, leaving an increasingly unstable situation.

Thus, perhaps the single biggest need for increased funding at the present time is for one-time grants to restore the longevity of a significant proportion of existing research grants. One form of longevity that is *not* particularly useful is the multiyear grant, whose renewal is not considered until close to the date of termination. Such a grant increases costs with little compensating gain in stability, since uncertainties about future commitments persist throughout the life of the grant. Instead, we suggest that consideration be given to several other funding methods of proven feasibility:

*Step funding.* Under a system of step funding, a research project is allocated support for several years ahead, but in declining steps. Thus, for example, a five-year grant might be full-funded for the first year, four-fifths-funded a second year, three-fifths-funded a third year, and so on for five years. At the end of the first year, the grant would be reviewed; if it were judged favorably, one-fifth-funding would be added for each of five years ahead, thus restoring the long-term financial assurance that existed at the beginning of year one, at the cost of only one additional year's funding.

As long as the merit of the project was recognized in the annual review, at least one fifth of the original grant would be assured for five years ahead, and these funds could be used to guarantee the continuing employment of key research personnel.

*Roll-forward funding.* The roll-forward scheme was used by the ARPA Materials Laboratories in the early 1960s. It works very much like step funding except that full funding is guaranteed for several years, and then one additional year's funding may be added every year, if a

review of the project is favorable. For five-year funding, this plan requires the appropriation of money for five full years at the beginning, whereas the step-funding scheme requires only three years of "front-end" funding.

*Longevity funding.* Most nonprofit research institutes supported by federal funds receive, in addition to overhead payments, a "management fee" that is often used to underwrite the salaries of individuals on the staff whose time cannot be charged to specific projects. The availability of such fees has made it possible for research institutes to develop new program areas to a point at which they can attract specific support and thus has enabled such institutes to grow creatively. Universities should be permitted to receive similar fees, especially for work undertaken at the initiative of the government. A university might also be permitted to set aside a certain percentage of a research grant each year to underwrite a long-term guarantee, or salary reserve, for a few core senior personnel.

**Recommendation 5**

**We recommend that a range of funding methods, including step funding, roll-forward funding, and longevity funding, be incorporated in federal grant procedures, to encourage longer-term planning and to promote the greatest possible degree of stability, flexibility, and effectiveness in federally aided research projects.**

## A NEW APPROACH TO OVERHEAD COSTS

Probably no single issue in research funding has been more divisive than the subject of meeting university overhead costs. This issue has been a special problem in

the years of declining funding, since overhead costs have tended to rise more rapidly than direct costs, resulting in an even greater decline in direct funding of research than is apparent from the usual statistics.* The present system of allocating funds, followed in all federal agencies except NIH, tends to pit researchers against their own university administrations and program officers against their agency heads. The program officer and the researcher have a common interest in circumventing their institutional superiors in order to channel more funds into support of the direct costs of research. This is a poor way to do business. A far better approach is to allow overhead payments to universities to be made out of a segregated pool of funds separated from the programmatic funds of each federal agency. The total overhead payment to a university can still be based on a negotiated rate between the agency and the university administration, but the overhead-payment funds in the agency should be handled by administrators other than program officers. Overhead costs should not appear in the budgets of individual projects evaluated in the peer-review process. Negotiation on the overhead rate between the agency and the university administration should not involve the investigator or the program officer and the scientific advisers.

*Although faculty members and congressmen sometimes voice the suspicion that universities arbitrarily boost the amounts charged for indirect costs, independent studies do not bear out this claim. Indirect-cost budgets have had to bear almost all of the heavy new costs resulting from federal regulations. In addition, the cost of many indirect items, such as utilities, equipment, books, and periodicals, has been rising much faster than the wages and salaries that make up the bulk of the direct costs (Bruce L. R. Smith and Joseph J. Karlesky, *The State of Academic Science: The Universities in the Nation's Research Effort* [Change Magazine Press, 1977] pp. 201–202).

**Recommendation 6**

**We recommend that all federal agencies supporting research in universities follow the practice of the National Institutes of Health in providing overhead payments out of funds segregated from agency funds designated for the direct support of research projects.**

## PROJECT AWARDS FOR EQUIPMENT

There is an accumulated backlog of relatively small equipment needs resulting from the recent decline in the percentage of research-project grants devoted to the purchase of equipment. This deficiency poses a major risk to the vitality of research, since it inhibits the exploration of new problems and new fields of inquiry and threatens to drive able scientists away from experimental work and into theoretical inquiry, for which expensive new equipment is not needed. An injection of new funds is required to overcome this backlog of equipment needs, estimated at $275 million.[18]

If the federal government increases its commitment to financing research equipment in universities, the universities themselves have an obligation to provide assurance that the equipment will be used as efficiently as possible and not duplicated unnecessarily by investigators, either on the same campus, or, indeed, in different institutions that could share equipment. Thus, one of the criteria for awarding equipment grants should be the effectiveness of management schemes for ensuring the efficient use of the equipment throughout a campus. Where particularly expensive equipment is to be funded, preference should be given, among proposals of approximately equal merit,

to requests that envisage the sharing of the equipment among several institutions. In making such judgments, however, the government must recognize that only scientists who are thoroughly conversant with a research field can judge when equipment can or cannot be shared effectively among researchers.

**Recommendation 7**

**We propose that Congress provide additional funding of $100 million a year for the next three years to be allocated to academic departments or research centers for the purchase of equipment. In addition we recommend a federal policy of increasing the percentage of project awards devoted to equipment from the present 5 percent level to the 10–15 percent range of a few years ago. The increased grants devoted to equipment should come from new funds, rather than from the reallocation of money previously used for other aspects of a research project, such as the support of personnel. Investigators seeking grants for equipment should be required to submit their case for rigorous review by disinterested peers.**

## FUNDING FOR SPACE AND FACILITIES

Since 1967, federal funding for new construction or modernization of research buildings has all but disappeared, except in a few areas such as cancer research. It is true that the need for new construction is much less than it was when enrollments and faculties were growing rapidly. Nevertheless, existing research space requires periodic modernization. The need has become especially urgent recently in view of new requirements for occupa-

tional health and safety, new standards for handling dangerous biological materials, and new legal mandates for improvement in such facilities as experimental-animal accommodations. The cost of modernizing facilities in many areas of research has become so large as to threaten the continued existence of experimental science on many campuses. As a result, there is a critical need for a catch-up program similar to that recommended for permanent equipment. Such a program should represent something more than a "wish list." It should be based on a carefully considered and specific summary of needs, expressed in some order of priority. To avoid parochial or self-serving assessment, the needs of any one institution should be evaluated by a group of scientists and administrators that includes representation from other institutions and from nonacademic research organizations. The evaluation should result in specific recommendations to government for a modernization plan to be carried out over a period of years.

**Recommendation 8**

**We recommend that the government allocate $150 million a year to the renovation of university research facilities (including renovation designed to reduce operation costs and energy consumption). To assist the government in the administration of this program, such an organization as the Association of American Universities or the National Academy of Sciences should be encouraged to establish a task force to make an overall assessment of the need for the modernization and improvement of research space in the universities.**

## STRENGTHENING PLURALISM

It is desirable to maintain a considerable degree of decentralization in the authority to make decisions about basic research. Decentralization ensures that idiosyncratic policies or judgments of any one federal agency, program officer, or congressional committee will not unduly hamper or distort the development of a particular field of science. From time to time, the federal administration has promoted decentralization by making clear that mission-oriented agencies should themselves support basic research related to their mission, broadly defined. But the degree of pluralism in academic research has been eroded in the recent period of financial stringency, and the situation has been made worse by various congressional mandates, such as the Mansfield Amendment limiting the kinds of research supported by the Department of Defense, which have forced certain agencies to take a very narrow view of just what research is related to their mission. We feel that the health of academic science requires a strong reinforcement of the principles of pluralism in decison-making. A policy of supporting basic research, as well as problem-oriented, applied research, is at least as important for the agencies as for the universities. In agriculture, for example, more extensive basic inquiry into the fields of photo-synthesis and nitrogen fixation is essential to making such important advances as the development of higher-yield crops and the lessened dependence on costly oil-based fertilizers. To promote greater pluralism in the support of basic research we make the following specific recommendations:

**Recommendation 9**

**The occasion of the reestablishment of the Office of Science and Technology and the presidential science-advisory apparatus should be taken as an opportunity for public reaffirmation of the principle of pluralism, with a presidential directive to mission-oriented agencies urging them to support basic research related to their missions.**

**Recommendation 10**

**The program of equipment grants summarized in Recommendation 7 should be extended as broadly as possible among mission-oriented agencies. In addition, the policy of making facilities in government laboratories available for research by academic scientists should be reaffirmed by the federal government.**

**Recommendation 11**

**We urge that further study be given to proposals for employing user taxes to derive revenue for support of particular kinds of research. For example, a tax on health insurance could provide support for medical research, a tax on energy could provide support for energy-related basic research, and so on. Wherever a type of research can be directed toward a particular segment of the economy, consideration should be given to supporting a portion of the related basic research by a tax based on volume of that particular economic activity.**

## PROVISIONS FOR LONG-TERM PLANNING

The legislation creating the new Office of Science and Technology contains a provision for annual five-year

projections of the support of scientific research. At the same time, the American Association for the Advancement of Science has established a program to develop an annual review of research priorities in the federal budget along lines similar to the annual analysis of overall budgetary priorities and alternatives published by the Brookings Institution over the last five years. These developments, combined with the establishment of the congressional budget office, provide a more favorable climate for long-term planning for academic research than has existed for some years. If such planning can be combined with the use of long-term funding such as we have recommended, the government will have taken a giant step toward restoring the vigor and stability of the scientific enterprise.

While we recognize that basic science cannot be entirely insulated from the annual congressional appropriations process, we do believe that it needs such insulation more than most other government activities. Even though a five-year plan is not a guarantee, the ability to predict future funding with at least some measure of confidence is essential to good research planning.

**Recommendation 12**

**We recommend that a method of projection based on man-years of scientific effort and average support costs for various areas of science be the main basis for long-term planning for academic research. We believe that a particularly important aspect of forward planning is the effort to take account of inflation and to monitor carefully the changing cost elements in research. We further**

**urge that an effort be made to project new needs for equipment and to anticipate their probable support costs.**

## NEW OPPORTUNITIES FOR DIALOGUE

At present, there is no effective way in which research universities can interact on a continuing basis with the government officials responsible for research planning, including those at OMB and on the various committees of Congress exercising oversight of the national research enterprise. New government rules are constantly being made without adequate appreciation of their impact on research and on research institutions. Conversely, government officials often become troubled by trends in research and education without the scientific community's becoming aware of their concern. There is less understanding between government officials and universities than there was a decade ago, even though individual academicians are more involved in the formulation of government policy than ever before.

The reestablishment of the Office of Science and Technology offers an auspicious occasion to create a forum in which academic scientists and university administrators could interact with government officials and congressional staff members. The position of Science Advisor in the White House might provide a corresponding locus for dialogue in the Executive Branch.

**Recommendation 13**
**We urge that the Office of Science and Technology and the Science Advisor give high priority to the reorganization of appropriate forums in which representatives of the universities and of federal**

**agencies can join in continuing, responsible discussions of the goals, methods, needs, and potential of the national scientific enterprise, so as to ensure the most effective use of all potential sources of support and to strengthen the leadership of the United States in science and technology.**

NOTES

1. *Science, The Endless Frontier,* a report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development (Washington, D.C.: U.S. Government Printing Office, 1945; reprinted by the National Science Foundation, 1960).

2. Ibid.

3. National Science Foundation, *National Patterns of R&D Resources, Funds and Manpower in the United States, 1953-1976,* NSF 76-310 (Washington, D.C.: 1976).

4. Ibid.

5. Ibid.

6. National Science Board, *Science Indicators 1974* (Washington, D.C.: National Science Foundation, 1976).

7. *Science, The Endless Frontier.*

8. *Science Indicators 1974.*

9. J. H. Comroe, Jr., and R. D. Dripps, "Scientific Basis for the Support of Biomedical Science," *Science* 192 (1976) 105-111.

10. *Science Indicators 1974.*

11. *National Patterns of R&D Resources, 1953-1976.*

12. Office of Management and Budget, *Special Analyses Budget of the United States Government Fiscal Year 1978* (Washington, D.C.: U.S. Government Printing Office, 1977), pp. 290-311.

13. National Academy of Sciences, *Survey of Research Equipment Needs in Ten Academic Disciplines* (Washington, D.C.: 1972).

14. *Science Indicators 1974.*

15. Ibid.

16. Thane Gustafson, "The Controversy Over Peer Review," *Science* 190 (1975): 1060-1066.

17. *Science Indicators 1974.*

18. *Survey of Research Equipment Needs.*

# Graduate Education: Priorities for the 1980s

Graduate education, scholarship, and research conducted within the nation's universities are of immense and continuing importance to the nation's economic and cultural development. Graduate education performs a number of vital functions for the entire educational system and thus for our society. Graduate schools are the "teacher of teachers" and are the training ground for research personnel and for professionals who translate knowlege into action. The vast majority of the nation's basic scientific research is conducted within the universities, often with graduate education an integral part of the research program. The nation's continuing investment in research and graduate education contributes in essential ways to the development of new ideas, new processes, and new areas of knowledge. Although some changes in focus and in level of activity are now required, these functions of graduate education are essential and enduring.

Policies toward graduate-student support (particularly federal policies) have an important effect on the

number of graduate students enrolled in universities, the composition of the graduate-student population, and the distribution of graduate students among institutions and fields of study. These are all matters of considerable importance to the strength and vitality of graduate education. The recommendations that we present here are based on the lessons we have drawn from recent experience and on our sense of the priorities for graduate education in the 1980s, topics to which we now turn.

## Federal Policies of the Last Ten Years

During the latter half of the 1960s and culminating in 1972 with the enactment of the Basic Educational Opportunity Grant (BEOG) program, the federal government's priorities in higher education underwent a remarkable shift. An increased emphasis was placed on equality of educational opportunity and on ensuring undergraduate access to postsecondary education. We applaud and support the much-needed governmental attention to these issues, but we also note with deep concern that during this same period and thereafter the federal government's attention to advanced training and research diminished significantly.

Federal support for basic scientific research, for example, declined by 15 percent in constant dollars between 1968 and 1975. The number of federal fellowships and traineeships for doctoral students peaked in 1968 and then declined rapidly as program after program dating from the late 1950s and early 1960s was dismantled.

While the reduction in federal support for research

contributed substantially to the reduced demand for Ph.D.'s, expansion of graduate programs during the 1960s also contributed to a growing imbalance in supply of and demand for new doctorates. In 1960, 134,000 students were enrolled in master's and doctoral programs; by 1971, the number had increased to 386,000, an average annual increase in excess of 10 percent. In 1961, 173 universities awarded 10,400 Ph.D. degrees; in 1972, 254 universities awarded 33,000 Ph.D. degrees, more than tripling the rate of production in twelve years. Although many factors account for this rapid growth, it is in part attributable to an expansionist federal policy in the immediate post-Sputnik years: the nation's graduate schools increased their enrollments dramatically, new graduate programs were started in institutions that had not formerly offered doctorate-level work, and the supply of individuals with high-level training was sharply increased. By the early 1970s, the federal government, with the cooperation and support of state governments and university faculties and administrators, had engineered a remarkable and widely dispersed expansion in the graduate enterprise. That such growth rates could not be sustained should have been evident; however, the abrupt cessation of the federal programs that underwrote this expansion was difficult to absorb and contributed to the current financial difficulties of the universities. Coupled with the reversal of federal policy toward graduate education was an equally sudden deterioration of the academic labor market. By the early 1970s attention was turning to a potential oversupply of new Ph.D.'s.

Although they were not explicitly stated, national

policy toward graduate education during this period was based upon several assumptions. The first was that there existed a national need for citizens capable of undertaking the advanced research that can add to the store of knowledge on which society depends. The areas in which this knowledge was needed were relatively well agreed upon. The need was most clearly accepted in the sciences; even in this period of growth, federal support for advanced research in the humanities and the social sciences was limited.

The second assumption of national policy was that people with advanced training were needed in our educational institutions not only to assist in the process of knowledge acquisition but also to teach. This need was made urgent by the enormous increase in undergraduate enrollments during the period. When, however, enrollment in colleges began to stabilize, this second guiding assumption lost much of its validity.

In retrospect, there may have been some lack of foresight at the federal, state, and campus levels during the 1960s that contributed to the creation of the current excess capacity in graduate education. The widespread belief that the nation's economy would require a growing number of Ph.D.'s—a belief that lasted in some quarters well into the 1970s—might have been tempered earlier had more careful attention been paid to the changing demographic factors that have reduced the demand for college teachers.

The important lesson to be learned from recent experience is that federal policy toward research and toward the education of research personnel should be based on long-term considerations and on a commitment

to quality, rather than on short-term shifts in the labor market or in the popularity of public issues. Steady and relatively dependable support for research and graduate education of the highest quality will be vastly more effective, economical, and efficient in the long run than the unpredictable swings in support—both up and down—that have marked the last fifteen years. Given the long training times associated with graduate education, the Ph.D. labor market is likely to experience considerable disequilibrium under the best of circumstances; rapid shifts in federal support only add a further destabilizing element, turning labor-market shortages in one period into surpluses in the next.[1] Since the federal government is a major source of graduate-student support, it is particularly ironic that the government's own policies often serve to undermine the value of its educational investment.

## The Outlook

Having noted some of the problems caused by previous failures of foresight, we must try to avoid similar mistakes in developing policy for the 1980s and beyond. A basic dilemma faces any activity such as graduate education in which program development spans many years. On the one hand, long-range planning and accurate forecasting are vital to such activities, since the results of decisions made today will not be apparent for several years; on the other hand, our ability to forecast trends in the economy and in society with any accuracy five to ten years ahead is notoriously poor. Since decisions must be made, we have no alternative but to use the

best available information about future trends, always remembering, however, that unforeseen events will likely swamp any forecast, and guarding against that circumstance as best we can.

We are persuaded that advanced training for research and teaching will continue to be important in determining our nation's well-being during the remainder of this century. We also believe that the federal government has a critical role in fostering an adequate supply of talented manpower and providing financial support for the young men and women undertaking graduate study. As we indicated earlier, a steady and sensible policy is essential to avoid unnecessary and disruptive changes in the nation's capacity to produce scholarly research.

We are painfully aware of the problems caused by the current excess supply of Ph.D.'s in a number of fields, but we believe that both students and universities have responded—and can be expected to respond further—to the changing economic environment. This point is obvious and would not require mention were it not that the various federal agencies that continue to publish projections of the Ph.D. supply largely ignore it.[2] In fact, the number of doctorates awarded in the last four years has essentially held steady at approximately 33,000, rather than growing at rates extrapolated from those of the 1960s. Employment problems will continue to be severe in those fields that have traditionally depended upon academic placement, but the pronounced reduction in the growth rate of Ph.D.'s awarded—and the absolute drop in the number of degrees conferred in certain fields, such as physics, chemistry, and engineering—tempers forecasts of a "Ph.D. glut" made by those who ignore

behavioral responses on the supply side of the market.

An important element in an assessment of the present and future of the graduate-education enterprise is the recognition that increasing numbers of women and minority students are enrolling in graduate study. The number of Ph.D.'s awarded to women has climbed from 1,250 in 1961 to nearly 7,700 in 1976, an increase from 12 percent to over 23 percent of all doctorates awarded in those years,[1] and it seems likely that this trend will continue. Although the number of doctorates awarded to blacks and other minority-group members has increased in recent years, several of the major graduate schools have reported declines in minority applications in recent years, suggesting that concerted action by universities, state and federal governments, private foundations, and the business community will be necessary if further gains are to be realized.

Most observers agree, however, that the nation's current capability to supply advanced education and research is greater than the foreseeable demand for such services over the next ten to fifteen years. The challenge that is posed, therefore, is the difficult task of adjusting the system downward and refocusing parts of it in line with the best judgment regarding future needs. Because higher education in the United States is not subject to central control, the adjustments will require coordinated action by university administrators, faculty members, students, governing boards, state and federal officials, graduates, the business community, and private foundations. The federal role is carried out almost exclusively through financing policies, since explicit decisions regarding the fate of individual graduate programs are not

made in Washington but at the campus or state level. *The federal financial role is critical, however, since federal dollars underwrite a large proportion of the costs of graduate education and research.* While the future level of federal support will be a crucial determinant of the strength and vitality of graduate education, equally important are the purposes to be served by federal dollars and the mechanisms used to allocate those dollars among activities and institutions. Consquently, our recommendations address all three of these features of federal support for graduate students.

## National Goals for Graduate Education in the 1980s

1. First and foremost, we believe that the highest-quality programs in all fields of graduate study should be strengthened and maintained, without reference to their geographical distribution, their connection with either publicly or privately controlled institutions, their proximity to population centers, or any other such factors that influenced policy during the decades of growth. A great danger is that when retrenchment or redistribution of resources is called for the problem will be handled politically, with the effects of policy decisions distributed "equitably" among existing programs. Rather, hard choices need to be made to maintain and strengthen some programs while eliminating others. This concern applies at all levels of the decision-making process—within an individual university in the choices that must be made among programs, with a multicampus system in the choices that must be made among programs on the

various campuses, and within the government in the financing choices that must be made by federal institutions and agencies. Graduate education at the doctoral level is simply too expensive and too important for the nation to accept its being done poorly; its unique value to society lies in the quality of education provided and in the quality of research accomplished.

The quality of any graduate program depends to a large degree on the quality of the students it attracts. If the graduate education of this country is to maintain a position of excellence and is to contribute in the greatest measure to our society, then it must be open to those students demonstrating the greatest degree of both achievement and promise, regardless of their financial resources. Thus student support, awarded on the basis of merit, is central to any effort to maintain the highest quality in advanced education and research and is an appropriate concern of national policy.

A further reason for stressing quality as the criterion for the support of graduate programs is that the two principal "products" of doctoral education—individuals with advanced understanding and new research findings—provide benefits to society that are not dependent on the location of the universities where the education and research are done. The labor market for the highly educated is national, even international, in scope; regions lacking a doctoral program in a given specialty are not deprived thereby of the services of people with such training. Similarly, research findings make their way into the national and international domain, regardless of where produced. Thus the concern for geographic distribution that properly influences decision-making at

the secondary and postsecondary levels of education is of less significance at the graduate level.

2. Although we do not favor centralized manpower planning and regulation, we do believe that the supply of persons with advanced degrees should be kept in reasonable balance with the long-term demands of our complex, technological society. We acknowledge that doctoral education requires a substantial investment of society's and the student's resources and, therefore, should be viewed largely as professional education leading to a career that makes reasonable use of that education. By implication this judgment means that it is appropriate for the federal government to use its resources to attract students into newly developing areas of study where manpower shortages loom. Without some guidance, potential students may be slow in identifying these fields and in responding to the newly recognized manpower needs.

3. We believe that greater diversity and a more explicit differentiation of function among graduate programs should be encouraged in order to meet the needs of a more heterogeneous student clientele. Universities that currently have the resources required for high-quality Ph.D. programs should continue that important activity. These programs are not, however, the only model. Other institutions should be helped to develop graduate programs with a more applied focus, serving the need for career-oriented education beyond the baccalaureate. Graduate education, often at the master's-degree level, should be available at these and other institutions to meet the requirement of students who need part-time programs offered in the late afternoon or evening and of

professionals who need refresher programs. The country does not need 250 universities equipped to enroll full-time students for the research Ph.D. degree; it does need a more rational division of labor among institutions in meeting social needs for a variety of advanced educational opportunities.

4. Finally, we believe that a special effort is needed at this time to increase the number of minority students who undertake and successfully complete doctoral programs. The national effort to increase the number of minority citizens on college and university faculties cannot possibly be successful until the supply of minority citizens with doctoral education is increased. Currently, blacks, Chicanos, Puerto Ricans, and American Indians represent less than 1.4 percent of all U.S. scientists and engineers holding doctoral degrees; in 1973-74, minority-group members received only 5 percent of the doctorates awarded to native-born citizens.[4] It is clearly in the long-run interest of our society for the composition of college and university faculties to be more representative of our citizenry, and hence the effort to increase the number of minority citizens who are qualified for faculty positions should have high priority. Fellowship programs focused on this priority are essential to achieving this purpose.

### Allocation Mechanisms of Federal Support

Federal support for graduate education can be allocated among students, fields of study, and institutions in a rich variety of ways, most of which have been used at one time or another in the last twenty years. Federal fellow-

ships have been awarded directly to students on the basis of academic promise in national competition; fellowships and traineeships* have also been allocated to universities, with the awards being made to the institution's own applicants. The first procedure allows the student to select the university he or she wishes to attend, taking the fellowship and accompanying cost-of-education allowance to that institution. The National Science Foundation Fellowship program operates in this fashion, as do many private foundation programs, such as the Danforth Foundation Fellowships. The free choice of students in selecting an academic institution for graduate study does not ensure a broad geographic distribution of fellowship holders. Therefore, fellowships such as the now-defunct National Defense Education Act (NDEA) Title IV awards were distributed directly to a large number of universities in the 1960s as part of a conscious policy to expand graduate education throughout the country. Since the expansionary purpose of the 1960s is hardly relevant to the 1980s, and since the portable fellowships awarded to students both maximize student choice and provide indirect support to the programs of the highest quality, we think that fellowship support designed explicitly to reward and encourage high academic performance—in contrast to programs that are targeted at specific manpower shortages or geographical imbalances, or are designed to serve other public purposes—should be awarded directly to students rather than indirectly through institutions. We do not, however,

* Traineeships are grants awarded to universities for support of students enrolled in particular programs. They are often part of broader training grants, a form of support described in the next paragraph.

perceive the competitive portable fellowship as the principal means for increasing the number of minorities in graduate schools, a goal for which we shall make other specific proposals later in this section.

Institutionally based programs also provide useful sources of support for graduate training. For example, the training grants of the National Institutes of Health/Alcohol, Drug Abuse, and Mental Health Administration (NIH/ADAMHA) provide support for the operating costs of specialized training environments, including funds for equipment, laboratories, faculty salaries, and computer time, as well as stipends to support both graduate students and postdoctoral fellows. Federal agencies also continue to use traineeships to encourage students to enter new fields, the study of which is deemed to be in the long-run national interest. The National Science Foundation, for example, recently announced awards totalling $2,163,000 for graduate traineeships in energy research; the accompanying news release stated that "the awards, made to twenty-nine institutions that award doctoral degrees in science and engineering, are designed to increase the number of scientific personnel engaged in energy research and development."

The federal government also provides support for large numbers of graduate students by including funds for research assistants as part of research grants and contracts awarded to faculty members. These grants are generally awarded on the basis of national competition and hence tend to be concentrated in the strongest graduate programs, thereby increasing the graduate-student support capability of these programs.

Other forms of federal support for graduate students,

such as the G.I. Bill and federally subsidized loan programs and work/study programs, are made available following criteria not directly related to academic merit, field of study, or institution attended and thus provide support that benefits students in the entire range of graduate programs. It is worth noting that the G.I. Bill is currently the largest single federal program providing graduate-student support and that the number of eligible veterans will decline rapidly in the next several years. Although the Veterans Administration does not break the data down in detail, it is likely that the majority of veterans supported under this program are enrolled in professional or master's programs rather than in doctoral study.

*The most effective and efficient allocation mechanism in this time of limited growth and selective retrenchment is the competitive one,* such as is found in the NSF fellowship program, in the selection of institutions to be awarded training grants or traineeships, and in the peer-review process of awarding research grants and contracts.* We argued earlier that a national goal for graduate education in the next decade should be the maintenance and strengthening of programs of the highest quality, wherever they are found; a decentralized, pluralistic, competitive process is the most effective means to that end. We reject the proposition that only a certain number of outstanding universities be selected to receive federal support. Strong graduate programs can be found in universities not generally noted for academic excellence,

*The importance of the peer-review process in awarding grants for scientific research is discussed at greater length in the section of this report dealing with basic research.

while the more prestigious institutions all have specific areas of weakness. Consequently, our recommendations build on the existing strengths of competitively allocated federal support.

## Recommendations

### FELLOWSHIPS

Federal fellowship programs have borne the brunt of the retrenchment in graduate-student support since 1968, and the NSF predoctoral fellowship program in the sciences is the main surviving program, albeit at a reduced level. Approximately 550 new three-year awards are made each year under this nationally competitive program, at an annual cost of $11.4 million. The program is designed to identify individuals of high intellectual ability and achievement and provide them with effective encouragement—in the form of fellowship support and national recognition—to pursue full-time graduate study in their chosen fields. Although the number of new Ph.D.'s needed in the next decade will be smaller than in the past, the nation must continue to attract the ablest students into teaching and scholarship. Merit fellowships serve that vital purpose, and a modest increase in the number now awarded will help to ensure that our most capable students are trained for scholarly and scientific careers.

Unlike forms of graduate-student support that aim to strengthen particular programs or fields of inquiry, with student support a secondary consideration, merit fellowships are an expression of the nation's continuing commitment to high intellectual achievement. The rec-

ognition associated with winning the award in a national competition is as important as the stipend and provides an incentive for superior academic achievement during the undergraduate years. Since the stipend and cost-of-education allowance are fully portable, students are free to attend the graduate school of their choice, thereby strengthening the best graduate programs. Merit fellowships have an importance for the quality and intellectual vigor of the nation's colleges and universities that far exceeds their number or cost.

The current NSF program is limited, however, to the sciences and engineering; it excludes the humanities and the less quantitative social sciences. No comparable program exists in these fields to encourage and reward excellence. We believe this is a major defect in the current array of federal programs, for it is surely in the national interest to support and encourage high achievement in every domain of intellectual endeavor. Extending the merit fellowship program to humanistic fields would also demonstrate that the national interest in graduate education is not limited to science and technology. The National Endowment for the Humanities would be a logical agency to administer a program in fields not covered by the National Science Foundation, although an alternative to relying on existing federal agencies for the administration of merit-based fellowships would be the creation of a National Fellowship Commission, with members appointed by the President.

**Recommendation 1**

**We strongly support the existing National Science Foundation program of competitive doctoral fellowships and recommend that the number of**

**awards be increased to 2,000 annually. Until such time as this recommended increase in three-year fellowships can be accomplished, we urge the provision of 1,500 one-year fellowships annually, for the support of able students in their first year of graduate work, when the best educational policy suggests that they not be dependent on assistantships and other grants tied to specified research projects.***

**Recommendation 2**

**We recommend the creation of a merit-based fellowship program demonstrating the national commitment to scholarly excellence in the humanities and the social sciences. We propose that approximately 500 new awards be made each year, on terms comparable to those of the National Science Foundation program, and that the program be administered within the National Endowment for the Humanities.**

## RESEARCH ASSISTANTSHIPS

The encouraging increases requested for basic research in the administration's fiscal 1978 budget request suggest that research assistantships are likely to increase in importance in the total pattern of graduate-student support. For this increase to occur, faculty members must be encouraged to include graduate assistants whenever possible in staffing research activities, and federal agencies must encourage the use of project funds for this purpose. We believe that research assistantships

*The implications of this recommendation are discussed from a different perspective in the basic-research section of this report.

are an entirely appropriate and often desirable method for supporting graduate students after their first year of study and that full advantage should be taken of the opportunities to use this type of support.

The widespread use of research assistantships is limited, however, to such disciplines as the physical sciences and engineering, which receive large research grants. The humanities and most of the social sciences cannot rely on this form of support for more than a very small percentage of the students in these fields.

**Recommendation 3**

**We urge that universities and federal agencies take full advantage of the opportunity provided by increases in research funding to increase the number of graduate students receiving support as research assistants.**

### TRAINEESHIPS AND TRAINING GRANTS

As noted earlier, federal traineeships have proved their utility as a means of speeding up the flow of students and resources into new fields of study that need to be developed in the national interest. The principal drawback to this type of support is that traineeship programs can produce instability and inefficiency if they are initiated and terminated too rapidly in response to short-run considerations.

Training grants, which are used extensively by NIH/ADAMHA to support biomedical, behavioral-science, and clincal-training programs were the subject of a continuing battle between recent administrations and the Congress, with the Executive Branch proposing to phase out the grants and the Congress intent upon retaining

them. The budgetary uncertainty surrounding these programs during the last six years (including the uncertainty not only over appropriations but also over subsequent impoundments) has rendered this form of support difficult to manage efficiently, both within the agencies and in the universities. In an attempt to break the impasse over policy, the 93rd Congress included in the National Research Act (Public Law 93-348) a request that the National Academy of Sciences prepare an annual report on human resource requirements for biomedical research and on the implications of these findings for training-grant support. Although this procedure is still very new, it promises to be a sensible way out of the political wrangling and uncertainty that had hampered these programs.[5]

**Recommendation 4**

**Traineeships are effective as a principal form of graduate-student support supplied by mission-oriented federal agencies, and we support their continuation. We urge, however, that rapid fluctuations up or down in the level and focus of such support be avoided. Smaller sums, if provided with greater certainty over longer periods of time, will be more effective than larger amounts provided erratically.**

**Recommendation 5**

**We support the procedure created under the National Research Act whereby the National Academy of Sciences reports annually to the Congress on national manpower needs in the biomedical research fields, accompanying that report with recommendations for support of the NIH/ADAMHA**

**training grants. The issues surrounding the proper level and mix of support for these programs are too complex and too important to be decided in the absence of such careful study.**

## LOAN PROGRAMS

Existing student-loan programs are an essential supplement to other forms of graduate-student support, and it seems likely that the volume of graduate-student borrowing under these programs will continue to increase. The usefulness of these programs is limited, however, by the ceiling on borrowing, by the ten-year maximum repayment period, and by the absence of income-related repayment options.[6] Current loan programs are adequate as a modest and limited supplement to other forms of support; it would be irresponsible, however, to increase reliance on loans significantly without a major restructuring of the student-loan system.[7] Since we do not recommend that loans become the principal source of graduate support, we do not discuss the changes that would be necessary in that event. We are concerned, however, by the drift toward increased dependence on loans and by the lack of basic information on how well current loan programs are meeting the financial needs of graduate students.

**Recommendation 6**

**We recommend that the U.S. Office of Education finance a thorough study of the current status of graduate-student loan finance, including survey information on the volume of borrowing, cumulative debt levels, repayment experience, and availability of capital. This information should be linked**

**to projections of future borrowing levels to determine whether changes in loan limits, repayment schedules, and insurance provisions are necessary.**

**We understand that the Office of Education has begun a review of all student-assistance programs. We recommend that patterns of graduate-student support be included in the examination and that the total program of student support include provisions for graduate-student assistance.**

## INCREASED MINORITY-GROUP PARTICIPATION

One of the highest social priorities for graduate education at this time is to increase the number of minority scholars and scientists. While some minority students now enter graduate programs and receive support from existing sources, a special effort will be required to achieve a significant increase in the number enrolled. The issues involved in attaining this goal are many and complicated, but the central objective should be to set in motion a self-sustaining process wherein minority participation in the mainstream of graduate education and research is the norm rather than the result of special effort. As such, the success of the special program that we recommend in this section will be demonstrated when the program is no longer needed.

A thorough study of this topic has recently been completed by the National Board of Graduate Education, and we have drawn on their report, *Minority Group Participation in Graduate Education*,[8] in fashioning our recommendation for federal policy. It should be noted that the board's report advances recommendations for

sectors of society other than the federal government, and we concur in its view that a pluralistic effort is required.

Not surprisingly, one of the barriers to increased minority enrollment in doctoral programs is financial; for many minority students, the costs of graduate school combined with the loss of income during a four- or five-year doctoral program are nearly insuperable obstacles to attendance. Furthermore, there is a major element of risk facing the student contemplating graduate school: attrition rates for all students tend to be higher in Ph.D. programs than in programs leading to a professional degree, and even those who are successful face an uncertain job market. Consequently, there is a serious and understandable problem in motivating minority students to take the risk of entering Ph.D. programs. Although existing forms of graduate-student support do benefit some minority students, special efforts beyond the existing programs are required if we are to achieve a substantial increase in minority graduate enrollments. Money is needed for student support and to cover additional costs that a university incurs when it makes a substantial commitment to recruit minority students and ensure that they are successful in completing doctoral study.

Federal support for minority graduate students could be provided indirectly through competitive institutional grants, directly to students as fellowships, or through a combination of these two approaches. Because institutional commitment is essential, our recommendation calls for competitive institutional grants to be awarded to universities on the basis of submitted proposals, together with a demonstrated commitment in the form of cost-

sharing or evidence of prior effort in this area. The criteria for awards to institutions should include the adequacy of the institution's efforts to recruit students and to support them through counseling, as well as its ability, demonstrated by past experience, to place graduates in academic or other professional positions. Institutional grants could also include funds for cooperative efforts by groups of universities to establish summer programs and other means to improve recruitment. A maintenance-of-effort provision should be included to ensure that federal funds to not simply release for other uses those institutional funds previously used for minority students.

The competitive institutional grants that we envision would incorporate features found in the NIH training grants and in the NSF Science Development Program. Initial grants would cover a three- to five-year period, with renewal contingent on demonstrated success as measured by student achievement. Legislative authority for such a program is provided by parts A, B, and D of Title IX of the Higher Education Act of 1965, as amended in 1976; a technical amendment to this legislation might be required. We estimate program costs at approximately $8,000 per student per year; hence, a national program providing three years of support per student and building to an enrollment of 1,800 students by the third year would cost approximately $14.4 million annually. (The first and second years of the program would, of course, cost proportionately less.)

A number of complex and unresolved legal and constitutional issues surround the subject of support programs targeted on minority graduate students. We

are convinced, however, that special efforts will be necessary if the national goal of increasing the number of minority scientists and scholars is to be met. Private foundation and university resources are inadequate to the task; federal support is clearly essential.*

**Recommendation 7**

**We recommend that the U.S. Office of Education implement a program of competitive institutional grants for the purpose of supporting increased minority participation in graduate education. The funds would provide for a broad range of activities including student aid, tuition, supportive services, and administrative costs. Selection of grant recipients should be based on an evaluation of the institution's commitment to the goal and on the effectiveness of its existing programs.**

### INCREASED PARTICIPATION BY WOMEN

Women are underrepresented in graduate education, particularly in certain fields. They should be encouraged to participate by special efforts in universities and in the administration of publicly and privately supported fellowship programs. The figures argue for major efforts to enhance their scholarly role. In the physical sciences women constitute only 5.3 percent of the persons holding the doctorate. The figure for engineering is less than 1 percent. Most other disciplines and professions reflect to some degree an imbalance between the sexes in the higher levels of scholarship.

*We note with pleasure that approximately $3 million has been appropriated in fiscal year 1978 for first-year support of minority graduate fellowships under Title IX of the Higher Education Act. This worthy effort should be expanded in the years immediately ahead.

This picture of male domination of the scholarly world has begun to change, but it has a long way to go. For many years women received about 12 percent of the Ph.D.'s awarded annually; this figure started to rise in the 1960s and now stands at about 23 percent. The proportion of female candidates for the doctorate is even higher. But the processes of change are slower than they should be. A fundamental factor causing underrepresentation in the sciences is the well documented and unwarranted practice of both schools and colleges in steering women away from mathematics and the sciences.

At the college level and beyond, the system still tends to favor males for opportunities in advanced scholarship. To correct this tendency, the basic tactic should be a major effort by each university offering graduate degrees to find strong female applicants. Experience in recent years has demonstrated that a good faith effort directed toward this objective will produce results and that there need be no compromise with the quality of students admitted to Ph.D. candidacy.

**Recommendation 8**

**Added attention is needed to increase the number of women awarded National Science Foundation competitive doctoral fellowships. The selection committee should have this goal constantly before it and should itself have strong female representation. Special efforts are required to persuade able female bachelor's degree holders to apply for these fellowships.**

**Recommendation 9**

**When the new fellowship program outlined in Recommendation 2 is instituted, it should incorpo-**

**rate both processes and goals designed to increase participation by women.**

NOTES

1. For a more detailed discussion of the government's labor-market orientation, see Richard B. Freeman and David W. Breneman, *Forecasting the Ph.D. Labor Market: Pitfalls for Policy*, Technical Report No. 2 of the National Board on Graduate Education (Washington, D.C.: National Academy of Sciences, 1974).

2. See, for example, United States Department of Labor, "Ph.D. Manpower: Employment, Demand, and Supply 1972-85," Bulletin 1860 (Washington, D.C.: United States Government Printing Office, 1975).

3. Commission on Human Resources, "Summary Reports 1976: Doctorate Recipients from United States Universities" (Washington, D.C.: National Academy of Sciences, 1977), p.4.

4. National Board on Graduate Education, *Minority Group Participation in Graduate Education* (Washington, D.C.: National Academy of Sciences, 1976).

5. The first substantive report of the National Academy of Sciences committee was released during the summer of 1976. For a brief summary of its recommendations, see "Biomedical Training: Time for a Slowdown," *Science* 193 (August 27, 1976): 747-748.

6. For a detailed discussion of these issues relating to student-loan programs, see National Board on Graduate Education, *Federal Policy Alternatives Toward Graduate Education* (Washington, D.C.: National Academy of Sciences, 1974).

7. Discussion of types of changes required can be found in D. Bruce Johnstone, *New Patterns for College Lending* (New York: Columbia University Press, 1972); Stephen P. Dresch, *An Economic Perspective on the Evolution of Graduate Education* (Washington, D.C.: National Academy of Sciences, 1974), pp. 67-76; and in Lois Rice (ed.), *Student Loans: Problem and Policy Alternatives* (New York: College Entrance Examination Board, 1977).

8. Cited in note 4.

# The Major Research Libraries: Strengthening a National Heritage

Much of the scholarly research carried on in the United States depends heavily on the bibliographic services, publications, and archival resources provided by a relatively small number of large research libraries. Many of these libraries are university-based, but their ranks are enriched in distinctive ways by the large national libraries (especially the Library of Congress), several private libraries (the largest and most notable being the Research Libraries of the New York Public Library), and a few old and exceptional public libraries. All are characterized by their extensive and distinguished collections on many subjects and in many languages. The libraries collect not only published materials in all formats but also manuscripts, sound recordings and graphic works, and computerized data. The staffs of these libraries are large, and the skills the staff members possess are as essential as the collections they build. The space these libraries occupy and provide for users is substantial, and the use of this space directly by users

themselves and indirectly through interlibrary loans and bibliographic services, is intense. Operating costs, like all educational costs, have grown rapidly.

Scholarship in all fields, the scientific and industrial vitality of the country, the national capacity to address public problems at all levels of organization, and, perhaps most important, the ability of individuals to pursue their own intellectual concerns depend to a significant degree on the availability of published information, which is the substance of research libraries. These libraries are indispensable to the preservation and transmission of knowledge and to the creation of new knowledge. Together, they are essential to the advancement of learning, and the quality of each directly affects the excellence of scholarship and research.

The importance of research libraries to our society was described recently by the National Commission on Libraries and Information Science:

> The major research libraries in the country, both private and public, represent the bibliographic foundation of the nation's research effort. Collectively, these institutions serve students, faculty, scholars, and researchers who are engaged in work in the sciences and the humanities, as well as the general public.
>
> [These] libraries in the United States have combined resources of over two hundred million volumes.... Their resources represent an asset of great value to the nation, and the Commission believes it is in the best interests of the country to assist these important institutions in forming a stronger set of working relationships that will permit them to serve more, rather than fewer, people....

Inadequate financial support is the central problem of the major research libraries, as we shall show, but they

also face other serious issues, including (1) the need to utilize computer and communications technology to transform library operations and to improve the process of information transfer; (2) the expanding expectations of users concerning collection coverage, speed of access, and reliability of service; (3) the necessity of balancing growing obligations and increasing technical complexity, on the one hand, with severe financial constraints that limit manpower and resources, on the other; and (4) a shortage of the specialized management skills required to meet the challenges posed by the growing complexity of library functions.

Moreover, although sharing the same mission and method, the libraries lack the means for working together at the level of sophistication that now seems necessary. Powerful new capabilities for cooperative action by research libraries are required, not primarily to reduce costs but rather to help make certain that expenditures for resources, space, skills, and technology in fact produce the desired results.

Change in the ways research libraries are operated and used is inevitable. The question is whether the transformation will be intentional, designed to enhance research libraries' effectiveness, or whether it will be forced, restrictive, and ultimately limiting. Acceptance of the principle of dynamic interdependence among libraries will require, first, a thoroughgoing appraisal of present practices. Imaginative utilization of new technology in computers, communications, and photography can and should transform and even improve many established library practices. A remarkable opportunity exists to extend the role of libraries and thus the ultimate impact

of research and scholarship. Not to move now in new directions is probably the most incautious course that could be proposed.

The libraries' own determination to undertake change is founded on the conviction that only by transforming bibliographic methods and collection goals can librarians cope with a constantly expanding body of material and set of user-generated requirements. The sense of urgency accompanying that determination stems from persistently rising costs and severely limited funds.

We noted earlier that most major libraries are university-based. Therefore their fate is closely intertwined with the continuing vitality of these advanced research and training institutions. This relationship now adds to the critical economic problems faced by libraries. While research universities have always provided significant support for their libraries, they themselves are now confronted by serious financial difficulties and can no longer shoulder alone the burden of sharply rising library costs.

Some specific examples of these costs underscore the magnitude of the economic problems facing libraries. During the two decades from 1950 to 1970, expenditures for books *doubled* every six or seven years, with costs for salaries and wages increasing at a rate only slightly slower. The number of books added annually to collections doubled every ten or eleven years. As great as these growth rates are, they are not abnormal; the growth rates in library costs per student are similar to the growth in total educational costs per student over the same period. Small libraries grew at a faster rate than large ones, suggesting that more and more libraries will become

very large and thus inevitably will share the problems the largest libraries now face.[1]

Recent years have also seen a distortion in the way available funds are used. The costs of publications have risen far faster than the general rate of inflation. In most libraries, funds earmarked for acquisitions have not kept abreast of rising costs. The difficulty has been further aggravated by a disproportionate rise in the cost of periodical and serial publications and an unprecedented increase in their numbers. In many research libraries, nearly two-thirds of the acquisitions budget is now spent for serial subscriptions, an almost complete reversal of the situation that prevailed little more than a decade ago.

In addition, increases in the numbers and costs of specialized materials such as legal and financial loose-leaf services have added thousands of dollars in new costs to the average research library's annual budget. Of even greater concern and impact has been the rapid extension of differential pricing practices, predominantly in the scientific, medical, and technical fields. Library subscription prices for hundreds of periodicals in these fields now range from two to ten times the rates charged to individual subscribers. This practice costs each library tens of thousands of dollars every year. In effect, differential pricing is a form of subsidy for scholarly and scientific publication by universities, with library acquisitions budgets simply serving as the conduit.

The net results of these inflation and cost problems is to force libraries and the universities that maintain most of them into a choice between reduced service to scholars and larger claims on the general funds of the university. Since other university activities are under similar pres-

sures, the choice offers no solutions and really demands that libraries find more efficient ways of providing their services.

Research libraries have taken a number of steps to alleviate some of their most pressing problems. An early example was the formation in 1949 by the Big Ten universities of what is now the Center for Research Libraries (CRL), a "library for libraries" with a national membership of over one hundred. To encourage resource sharing, special acquisitions programs have been established not only by the Association of Research Libraries and the CRL but also by the Library of Congress. The National Program for Acquisitions and Cataloging (NPAC) not only has expanded the level of Library of Congress acquisitions but also has effectively increased the volume and coverage of its cataloging, benefiting in substantial ways the many libraries that use Library of Congress records as a primary source for their own bibliographic work.

The application of computers to library operations and to bibliographic purposes is now more than ten years old. Many libraries use computers to control costs of routine processing and circulation, and a few have developed, at substantial cost in dollars and effort, impressive comprehensive bibliographic control systems. For example, the Ohio College Library Center provides an economical, computer-based catalog card production system used by hundreds of college and university libraries, and similar systems serve other institutions. Large quantities of bibliographic information both for monographs and, more recently, for periodicals, are now recorded and stored in machine-read-

able form at the Library of Congress and the National Library of Medicine. Some search-and-access systems for bibliographic information are operational and others are being developed.

More recently, regional affiliations such as the Research Libraries Group have been established to control collection growth, with member libraries assuming obligations for both specific subject areas or for specific materials; to attack the problem of safeguarding printed materials against deterioration; and to establish and operate a single, computer-based bibliographic records system, linked with an evolving national network.

Despite all these advances, several additional steps must be taken in the immediate future to preserve the vitality of the nation's research libraries and to help them meet their responsibilities to society. The actions called for are of such magnitude that success will be possible only through durable partnerships involving personal and institutional efforts and public and private resources. The way in which those partnerships are established will do much to determine the speed and quality of our progress.

## Recommendations

### SUPPORT FOR RESEARCH COLLECTIONS

The subject of library resources is more complex than it once seemed, but it is still the case that distinctive, extensive, dynamic, and well-organized collections of materials on specific subjects constitute the heart of a research library. Every large research library typically has many such collections and, aggregated nationally,

these collections are a form of irreplaceable wealth. Exceptional collections are created less frequently now, and most of those that exist are maintained with increasing difficulty. The high cost of continuing acquisitions, the physical deterioration of materials, and the expense of maintaining the necessary skilled staff are all problems of growing magnitude. The hazard they pose to future intellectual vitality is serious.

The importance of comprehensive research collections to scholarship was clearly noted by the Carnegie Council on Policy Studies in Higher Education. Acknowledging the present difficulty of maintaining such collections, the council asserted that "the case for some degree of federal government support of large research libraries is precisely parallel to the case for federal government support of research and graduate education." This principle was recognized by Congress in enacting Public Law 94-482, the Education Amendments of 1976. This statute authorizes the Commissioner of Education to make grants for library resources to major research libraries at a level of $10 million during fiscal 1977, $15 million in fiscal 1978, and $20 million in fiscal 1979. The Senate report notes that "the new part C is intended to help research libraries maintain and strengthen their collections, which constitute an important national resource essential to scholarship and research, and to assist them in making their holdings available to other libraries whose users have needs for research materials."[4]

The general guidelines incorporated in the Senate report extend eligibility for federal support to institutions of higher education, public libraries, state libraries,

and private, nonprofit, independent research libraries, provided that their collections "make an indispensable contribution to higher education and research, are broadly based, are recognized as having national or international significance for scholarly research, are of a unique nature, not widely held, and are of such importance that fairly substantial demands are made upon the institution by researchers and scholars outside its primary clientele." The provisions of the governing regulations, which have yet to be written, will influence in important ways the evolution of a more purposeful national program for resource development, materials preservation, and shared access. The close adherence of the regulations to legislative intent, together with full funding, will reflect a growing and reassuring comprehension that the well-being of research and scholarship is closely linked to the quality of exceptional libraries, and that strengthening the research libraries is in the nation's interest.

**Recommendation 1**

**We recommend that regulations governing part C of Title II of the Higher Education Act of 1965 as amended in 1976 be given immediate and careful attention, and we urge passage of an appropriations bill adequate to carry out the provisions of the legislation.**

## A NATIONAL LENDING LIBRARY

Although subject collections of high quality are the heart of research libraries, the sheer volume of publication, nationally and worldwide, is reason enough for libraries and users alike to recognize that comprehensive coverage

of all subject areas of possible research interest is no longer an achievable goal for any single library. Adding to the persuasive evidence are reduced library buying power, escalating costs for storage and collection maintenance, the prospect of infinitely growing collections, and the inevitably limited use made of most individual items.

The library profession has acted responsibly in seeking realistic alternatives to the traditional policies governing the acquisition, use, and maintenance of materials. Perhaps the most promising possibility is to extend in scope and effectiveness the concept of a "library for libraries" as embodied in the Center for Research Libraries. The principle underlying CRL is that the Center will collect comprehensively in specific format or subject categories, thus giving participating libraries an assured source of these items and thereby reducing their acquisitions obligations without curtailing their service capabilities. In effect, the availability of comprehensive shared collections enables individual libraries to concentrate on maintaining distinction in chosen areas rather than spreading their limited resources too thin in futile pursuit of complete self-sufficiency.

The Association of Research Libraries, the National Commission on Libraries and Information Science, and the Center itself are all now participating in research and exploratory discussions that have as their goal the expansion of existing shared facilities or the creation of new national lending collections. Initial attention is being directed to periodicals and other serial publications, simply because these materials, by their growth in number and cost and their great diversity, are a leading

source and a representative example of present library problems. Whether an expanded national lending facility evolves from the Center for Research Libraries or some other course is taken, important questions related to governance and program remain to be resolved. Expansion of Center facilities is now essential even for the continuation of its established programs, to say nothing of new or expanded activities.

Ultimately, we believe, at least some federal funding for the continuing operation of any significant pool of research resources is essential in order to provide the assurance of continuity that is absolutely vital if individual libraries are to strengthen their own collecting and retention practices judiciously and confidently. This type of program is especially appropriate for federal funding since the impact of such support is amplified many times over as individual libraries throughout the country redeploy their resources to better effect and as access to important scholarly material is extended to increased numbers of scholars and researchers in all parts of the nation.

**Recommendation 2**

**We recommend that the federal government and other funding sources encourage and support national efforts of the sort exemplified by the collaborative work of the Library of Congress, the Association of Research Libraries, the National Commission on Libraries and Information Science, and the Center for Research Libraries toward the establishment of a national lending library which would lead to greater sharing of library resources.**

## A PERMANENT COMMISSION ON LIBRARY RESOURCES

While additional public support for both distinctive subject resources and new national collections will expedite access, promote local operating efficiency, and assure the availability of needed materials, an additional step is required to meet the complexities of these and related issues. Building and maintaining research collections is too extensive and diffuse an enterprise to be centrally managed in any usual sense of the term, nor should information resources and the bibliographic processes that provide the key to their content ever be susceptible to restrictive control. Nevertheless, a way must be found for scholars, researchers, and all who depend on substantive information for their livelihood, along with library administrators who are in the end responsible for meeting their needs, to assess routinely the quality of national resources and, when necessary, to influence or promote action by responsible agencies and institutions to strengthen these resources. Librarians and scholars alike can do themselves and the country a great service if they can establish new ways to work together to accomplish their shared goals.

**Recommendation 3**

**We recommend that the Library of Congress explore with the country's leading learned societes and research-library organizations the possibility of establishing a permanent body to assess the quality of national library resources, to promote action by responsible agencies, and to help shape national policies.**

As the volume and complexity of worldwide publication has grown, traditional bibliographic control methods have become cumbersome and costly. As a result, abstracting and indexing services have expanded rapidly and become more sophisticated, enabling researchers to cope at least with the flood of journal and report literature in the natural and social sciences. Computer-based search services, employing many of the same data bases as the abstracting and indexing services, complete searches of a kind not easily accomplished using printed sources alone.

For the great bulk of library materials, however, making fundamental changes in the preparation and use of bibliographic records has proved far more difficult. Substantial expenditures of effort and money over the past decade have only recently provided the base of knowledge and skills that today sets libraries on the threshold of a major bibliographic revolution.

The most visible and impressive accomplishments thus far are those that have automated much of the work of producing and maintaining catalog records and of carrying out many labor-intensive processing activities. As noted earlier the Ohio College Library Center now provides computer-produced catalog cards at low cost of hundreds of subscribing libraries. The New York Public Library has developed a computer-based record system that has enabled it to produce a published, periodically cumulated book catalog. Several large university libraries have developed comprehensive record-processing systems that have substantially improved acquisitions and cataloging work. Most prominently, the

Library of Congress has embarked on several programs designed to improve bibliographic processes within the library itself and also to expand the library's already substantial contribution to national and international bibliographic control activity and continues to support many projects and to provide professional guidance and assistance in many critical areas.

The immediate results of these and other related efforts are new methods of producing high-quality, standardized bibliographic information in increasing quantities, the development of new systems to use the information in a wide range of internal library operations, and the production of catalog cards and related records in a variety of formats. Recent progress is impressive, and prospects are now good that newly developed capabilities will benefit a growing number of libraries and their users.

There remain, however, many difficult and important questions to be resolved relating to the content and linking of records, to record-distribution methods, and to new forms of bibliographic products. The answers to these questions will influence in fundamental ways both individual library performance and our national capacity to support research and scholarship.

The Library of Congress is the established center for the production of high quality bibliographic records and is potentially the primary producer of both general and specialized bibliographic products. It is obvious that the library must continue to be the center for national bibliographic operations and that adequate budgetary support for this aspect of the library's activity is essential.

Not so clearly developed within the country's libraries is a capacity for long-range planning in matters related to bibliographic control. This element is much needed, given the dynamic character of present efforts and the possible impact of soon-to-be-made decisions on library operations and on scholarship and research. While several approaches are possible, it is certain that research libraries and their users, acting together, must find a way to address basic questions promptly.

**Recommendation 4**

**We recommend that the Library of Congress expand its role in national bibliographic operations and that the Association of Research Libraries and other representatives of libraries, together with representatives of the scholarly community and other users, join with the Library of Congress and other appropriate groups to formulate long-range plans for improving bibliographic service.**

The benefits to libraries and scholars alike of wise and imaginative guidance in these matters during the years ahead can be substantial. Such benefits are unlikely to come by accident.

## THE IMPROVEMENT OF LIBRARY MANAGEMENT

While the visible form of libraries will not dramatically change in the near future, their operating methods and the research methods of their users will change in many ways. As we said earlier, controlling the nature of this change is at the heart of our concern. Too little is known, however, about many fundamental matters of library management. More information than we now have is

required about the relationship between user needs and library services, the quality and utility of published information, the economics of library operations, and the potential capacities of technology appropriate to information processing. Further, there is a need to give users a better understanding of the needs of libraries and of the new ways in which libraries can be of service to their users.

**Recommendation 5**

**We recommend that the Association of Research Libraries establish a research and analysis unit to develop the information necessary for improving the managment of library services. The proposed unit would assemble data, conduct special studies, and promote research on topics of concern. The unit and the ARL itself would work to develop by consultation and communication better understanding of the nature of library problems and of the steps needed to solve them. One goal of this effort would be to strengthen relationships between users of research libraries and those responsible for operating them.**

## THE PRESERVATION OF LIBRARY MATERIALS

The preservation of library materials is a matter of great importance. Large portions of many of the country's oldest and most distinctive collections are literally crumbling on the shelves. Paper deterioration is most serious in materials published during the last 150 years, but these materials represent the great bulk of these collections, numbering many millions of volumes. It is essential that the content of these publications not be



110

lost, even if it proves impossible to save the volumes in their present form.

A number of studies have focused on the preservation problem, and several alternative courses of action have been proposed. It is obvious that no single method of preservation will suffice, but it is clear that a national program to film large and carefully selected quantities of deteriorating materials is an essential element in any full-scale preservation program. A few libraries have for some time committed operating funds to preservation efforts, but neither sufficient funding nor the essential framework of a national plan has been available, and these efforts have hardly scratched the surface.

The magnitude of the job to be done and its importance to the long-range interests of scholarship and research are irrefutable. The goal is not to preserve the resources of many individual libraries but rather to preserve the substance of an indispensable part of the record of human achievement. Thousands of books have already been lost, and hundreds of thousands are now so fragile that any further use is in effect the last use.

The Library of Congress has recently taken the lead in a new effort to establish and promote a national plan for the preservation of library materials. Coordination and operating guidelines are essential elements, but, in the end, federal funding is an inescapable requirement for any significant progress. In the immediate future, the means must be found to provide support for what is literally the preservation of our cultural and intellectual heritage.

**Recommendation 6**

**We recommend that the federal government give**

**urgent attention to the preservation problems faced by research libraries. Substantial funding and the leadership of the Library of Congress are both required to assure an effective national program.**

## NEW MODES OF COOPERATIVE ACTION

The major research libraries of this country are vital to the success of scholarly inquiry. The problems they face are immediate and urgent, and these problems will not be resolved by individual libraries acting alone.

Direct federal appropriations are required for certain specific purposes: (1) for supplementary support for the distinctive, nationally important collections that are found in individual libraries; (2) to provide capital and at least partial operating support for national lending collections; and (3) for a national program of microfilming. It is also clearly evident that the Library of Congress, as the national library on which all other research libraries are dependent in many ways, must assume a leadership role in solving the problems of bibliographic exchange. Only the Library of Congress is in the position to assume operating responsibility for the central elements of the automated bibliographic network that is essential to research and scholarship and thus to the survival of research libraries across the country.

Research libraries, individually and collectively, will still bear much of the responsibility for planning and directing their own futures, but they must press for change on a national scale, and they must use the flexibility that new national ventures will bring to reshape their own internal practices. They must find

ways to establish long-range planning capabilities in all areas of central concern, acting as inseparable parts of a joint venture of great public importance. Further, they must find new ways to expedite the work of scholars and scholars-to-be by opening in imaginative ways all useful avenues to recorded infromation, whatever its form.

Finally, the scholars, scientists, and other major users of research libraries have an obligation to participate productively in the development of more effective techniques and procedures. There is enough for all to do, and the well-being of research libraries now depends on how well all parties do their part.

NOTES

1. Herman H. Fussler, *Research Libraries and Technology* (Chicago: University of Chicago Press, 1973), pp. 17-19.

2. *Toward a National Program for Library and Information Services: Goals for Action* (Washington, D.C.: National Commission on Libraries and Information Science, 1975).

3. William J. Baumol and Matetyahu Marcus, *Economics of Academic Libraries* (Washington, D.C.: American Council on Education, 1973).

4. U. S. Senate, Report. 94-882 (Washington, D.C.: U. S. Government Printing Office, 1976).

# Helping the Research Universities Achieve Competence in International Studies and Research

As in each of the other sections of our report, we here focus on one aspect of the role of American research universities in meeting essential national needs. It is especially important in this section, however, to restate and reaffirm one of our initial propositions: American research universities are only a part—even if a critical part—of a vast network of educative and knowledge-producing agencies and instruments in our complex society. The major research universities are as dependent on the health of K-12 schools, two-year and four-year colleges, other comprehensive universities, adult and continuing education systems, and the mass media as all of these levels and kinds of educative instruments are dependent on them. This mutual dependence is especially evident in the field of international studies and research. Unless all parts of the educational system sense the importance of global perspectives, there will be neither a pool of motivated and relevant talent from

which research universities can draw their students and ultimately their faculties, nor a public and governmental receptivity to the intellectual contributions that American research universities may make to international understanding.

American research universities therefore look with signal favor upon federal policies designed to increase broad public understanding of global interdependence, policies such as the so-called Citizen Education Amendment to Title VI of the National Defense Education Act (designed to enlarge the perspectives of elementary and secondary pupils and of adults), the extension of NDEA Title VI and other federal funding programs to area and language programs in two-year and four-year undergraduate institutions, and the development of satellite telecommunications around the world. Enhancing the competence of America's research universities in international studies and research must be seen as an integral part of a larger national endeavor to increase the global sophistication of the citizenry and its leadership.

This larger national endeavor, in turn, must be seen in the context of recent massive changes in the nature and scope of America's international relations. In the last three decades, every American administration has found itself deeply engaged in great stretches of the world, in undertakings for which the education of its leadership and this nation's history had not prepared it. Before the Second World War, only missionaries, a few travelers, and a small number of businessmen, scholars, and foreign-service officers became directly familiar with the countries of Africa, Asia, and the Middle East. Most American leaders and most American institutions

viewed the world east and south of Suez only dimly, seeing it at second remove, through the lenses of the colonial offices of Europe, as a vast, exotic, and backward suburb of the West.

World War II jarred the romantic complacency of many Americans about these distant places. The military suddenly found a need to speak languages and understand countries that even its officers had scarcely heard of. Its crash courses in exotic languages were the beginning of what later came to be called area studies. The war itself might have left only transitory traces on American attitudes. The boys came home, and the nation tried to return to its customary vagueness about the far reaches of the world. But the recession of European empires that followed the war at last put a wrenching end to the vagueness and lack of interest that had characterized the attitude of the United States toward the third world. For the last thirty years as the United States has come face to face with scores of "new nations and old cultures," its growing involvement with the third world has progressively laid bare its ignorance of that portion of the earth and its peoples. In addition to this unanticipated confrontation with the non-Western world, we have faced an intense global competition with the Soviet Union and its Eastern European allies, a second world of which most Americans have known very little. Here again it has been clear that although American isolation has ended, American isolationism, in the form of unpreparedness in international affairs, has not.

In the first years after World War II, such urgent overseas needs as the rebuilding of Europe and the transfer of technical know-how to former European

colonies absorbed our government's internationally directed energies. The long-term need to deepen the nation's knowledge and understanding of other nations and societies was therefore addressed for some years not by government but by American foundations, which offered some support for university-based foreign area studies. It has required the waging of two wars in unfamiliar lands, the discovery that there are no "quick fixes" for the problems of underdevelopment, and a recognition that some international problems, such as population, energy, and the uses of the oceans, may not be soluble through the realpolitik of single nation-states to make clear the long-term need of the United States to achieve greater international knowledge and competence.

In any comprehensive national effort to meet this long-term need, the research universities have a vital role. Their potential contribution and their need for help in making that contribution are both great. If we look at the universities' own evolution since World War II, it is clear how far they have already come in meeting the country's need for international knowledge. It is also clear how far they still have to go in order to achieve, and thereby help the nation to achieve, full international competence. The paradox is obvious: the more "national" the universities remain, the less useful they will be to a nation that must henceforth make its way in an interdependent world.

In the Overview to this report, international studies are cited as one of the major parts of a university's "natural work." This is an important reminder that, as an institution, the university is older and broader than the

nation-state and may well outlive it. Bologna and Paris in the West, Al Azhar in the Middle East, and the ancient forest universities of South Asia preceded the modern states of Italy, France, Egypt, and India, and they drew both their faculties and their students from communities, such as Christendom and Islam, which transcended political boundaries. Gradually, as the present world of nation-states emerged, the faculties, student bodies, and curricula of these ancient universities contracted, in conformity with new national boundaries.

Of course, this contraction of purview was never complete. Mathematicians and natural scientists have never confined themselves to national sources but have taken knowledge where they found it, and humanistic studies in the universities of Europe and the Western hemisphere have all drawn on the Western classics of Greece and Rome. Nevertheless, although they have been among the least parochial institutions in their societies, modern universities *have* been parochial relative to their full "natural" role as centers of universal knowledge and value.

In the United States, preoccupied as it was until World War II with its own development as a continent-wide and isolated nation, the idea of a university as an instrument of national development (or even of regional or state development) had a special attraction. And even those American universities that aimed to be international in their reach remained, like the universities of Europe, "Atlanticist" rather than universal. Most topics of study were drawn from the experience of the United States and Western Europe, and the historical perspectives presented began in ancient Greece and Palestine,



113

moved westward to Rome, then north through Europe, and thence across the Atlantic to the New World.

Since World War II, and in response to the same circumstances that impinged on the national government, the national and Western preoccupation of American universities has been reduced in three distinguishable ways. The first has been the advanced training, principally in new or expanded area-study centers, of considerable numbers of scholars specializing in the study of "remote," non-Western areas, as well as of Eastern European and Latin America. The second has been the engagement of individual American scholars and scientists in international exchange programs and in technical-assistance efforts in the developing nations. The third change in the universities' stance has been more a process than a program. It is seen in the gradual accumulation of effects on the traditional academic disciplines and professions themselves of a widened attention to previously unfamiliar parts of the world. Whereas studies of Asian and African societies once tended to be confined to the research of anthropologists observing tribal life, now social scientists of all kinds have begun to bring the economies, polities, and cultural traditions of the new nations within the scope of their established disciplines. The same tendency is true of agriculturalists, medical specialists, engineers, management and business specialists, and legal scholars in the professional schools, many of whom in recent years have helped new nations to tackle their urgent and varied development problems.

This infiltration of the academic disciplines and the professional schools by concerns arising from both

European and non-European sources has caused some rethinking of educational values and emphasis in a more general sense. At the undergraduate level there is now considerable recognition that international studies in some form have an intrinsic value as part of a liberal education, that knowing about the culture and politics and economic system of a people other than one's own is indeed an important part of general education. This recognition is reinforced as young Americans study and travel abroad and subsequently draw on their experiences to augment their academic work. This new understanding of international studies, though growing, is not yet universal. The capacity to support it and make if effective depends on the continuing internationalization of the disciplines and professions in the universities. The great significance of this internationalization lies in its potential for creating an educated citizenry that can contend with issues the United States faces overseas.*

Clearly, American universities have begun to evolve in the direction that both the times and the true idea of a university require. Yet, given the scale on which internationalization is now required and the pace at which the need for it has been growing, it should surprise no one that much remains to be done and that to get it done the universities will need a great deal of help. The first order of business is to reverse the recent decline in support for the universities' postwar efforts to expand their international reach and thereby their value to the nation.

*An example of such issues is the accelerating internationalization of economic enterprise through the activities of multinational corporations. The basic knowledge and analysis which will help both to enhance the worldwide benefits of such agencies and to control their excesses starts with the work of scholars in universities.



120

As suggested, two principal routes to full competence in international studies and understanding are open to us: first, the continuing development of specialized centers of research on foreign areas and on international problems and, second, the internationalization of the disciplines and professions. The universities' progress along both routes is dependent upon increased support by the federal government.

In making the case for added federal support for international studies, it is important to begin with two points: (1) The universities themselves have long accepted and accept for the future the obligation to commit major resources of their own to the task of developing international studies. What is now sought is an improved, long-term *partnership* with government, rather than a transfer of the entire burden to federal funding agencies. (2) It would be naive to assume that universities have any magic answers or solutions. Instead, they have the capacity to assist in understanding international problems better, approaching them more rationally, and struggling with them more constructively.

## Centers of Foreign Area Studies and Problem-centered Research

### FOREIGN AREA STUDIES

A concentration of effort at a number of major research universities has been and still is vital to the development of all aspects of foreign area studies. Several elements make the role of the major research universities essential and irreplaceable and thus appropriate for federal attention and support:

1. The commitment of these universities to foreign area studies has been strong enough to maintain a critical mass of first-class scholars at work on the edges of knowledge in a range of cultural and disciplinary fields. These scholars and their students produce the bulk of worthwhile research and new concepts in the field. They also form a major part of the national pool of expertise on foreign lands and alien cultures on which the whole nation draws.

2. The major research universities have trained the great majority of the experts in the field who are now at smaller centers of foreign area studies, who teach courses in colleges, who are introducing international studies at lower levels of education, or who have become the few governmental area experts or trained journalists who have made distinguished contributions in the field.*

3. The specialized library holdings maintained by the major research universities are significant national resources, essential to advanced research and training. (In another section of this report we discuss more broadly the special challenges faced by the research libraries.)

4. The concentration of the research universities' resources, the breadth and depth of their research and teaching, and the vitality of the interactions they stimulate attract scholars from other institutions in the United States and from abroad, who come for periods of

*A 1970 survey showed that 87.3 percent of the students then training to be foreign area specialists were concentrated in only fifty programs located at twenty universities (Richard D. Lambert, *Language and Area Studies Review*, Monograph 17 of the American Academy of Political and Social Science, Philadelphia, October 1973). For similar detailed information, see also the unpublished 1975 report of Robert E. Ward and others entitled "The Role and Funding of Asian Studies Programs in the United States: A Report of the Presidential Committee on Professional Needs and Development of the Association for Asian Studies."

research and retraining in the advanced problems of the field. These universities serve as national reception centers for a constant flow of foreign scholars and foreign students.

5. The major research universities perform a significant outreach service by their publications and seminars for government, business, civic groups and lower schools. They are, and with augmented support could be even more, the natural centers for retraining teachers at the college or secondary level, enabling them to introduce or improve teaching about foreign areas at their institutions. The universities thus play an important role in the development of teaching materials and methods for the spread of these studies to the lower levels of education.

The foregoing case for foreign area studies is neither new nor, in principle, widely disputed. It is repeated here because assent to its validity has not so far led to appropriate and adequate funding. The short and erratic history of support for foreign area studies needs to be recalled. From a very small beginning before World War II, consisting large part of support by the Rockefeller Foundation, foreign area studies in American universities expanded considerably after the war. The universities themselves invested more and also received major assistance from the Ford Foundation. After the launching of the Soviet Sputnik in 1957, the federal government also contributed. Even then, however, foreign area studies fell short of meeting national requirements, and in recent years, despite the increasing national need, such studies have been declining as a result of rising costs and shrinking support.

Even disregarding the devastating effects of inflation, area studies are for several reasons necessarily more costly than perhaps any other field of study in the social sciences and humanities:

1. *Length of training.* Because of the difficulty of learning some of the languages, the unfamiliarity of much of the subject matter, and the remoteness or inaccessibility of many of the countries concerned, the training period leading to the Ph.D. degree in foreign area studies is appreciably longer than in most other fields, averaging around eight years in many branches. Even after achieving the Ph.D. degree, the scholar in the field generally needs a period of postdoctoral research to reach a productive stage. To maintain such a scholar through this long training period is a heavy financial burden.

2. *Expense of specialized language instruction.* The advanced study of Russian requires a number of years of intensive work with native informants, and the mastery of Chinese, Japanese, and Arabic similarly requires many years of study at advanced levels. The study of certain other languages, such as Korean, Vietnamese, Mongolian, Turkish, Iranian, the many lanaguages of South Asia, Southeast Asia, and Africa, and some of the languages of Eastern Europe and Soviet minority nationalities, engages such a small number of students and requires such specialized skills on the part of instructors as to impose an extremely heavy financial burden wherever these languages are taught. However, the national interest requires that a capacity to teach all these languages be maintained, even through times when it is not heavily drawn upon. It is always expensive and

difficult to begin programs in esoteric languages to meet a particular current need, and in some cases it may be impossible.

3. *Growing costs of specialized libraries in non-Western languages and non-Latin alphabets.* For libraries, books in the Cyrillic alphabet of Eastern Europe, the Arabic script of the Middle East, and the romanized but non-Indo-European writings of Africa, South Asia, and Southeast Asia present many difficulties. To these can be added the difficulties of the character system of writing of East Asia. Moreover, an avalanche of printed materials is now being produced in East Asia, to add to the already huge quantities of books produced in the past in China and Japan. These various languages and writing systems require the maintenance of special collections serviced by librarians with very special training. And, in the case of Chinese and Japanese, the collections approach a scale that begins to rival the traditional Western libraries of universities.

4. *The limited size of the most highly specialized fields.* Chinese, Japanese, Russian, Latin American, and even Arabic studies are now popular enough to draw relatively large numbers of students, and job opportunities within these fields are on a scale comparable to the more traditional areas of scholarship, but this situation does not hold for the for the smaller, less popular fields. Our relations with Korea, Vietnam, Mongolia, and all the various countries of South and Southeast Asia, including Bangladesh, Sri Lanka, and Nepal, create an important need for applicable economic, political, and cultural expertise in the United States. Our national interests in Iran and Turkey, the various national entities within the

Arabic world, the many regions and states of sub-Saharan Africa, and the smaller nations of Latin America do likewise. Moreover, our interests in large, complex countries such as India and the Soviet Union cannot be well served without knowledge of the diverse subgroupings of nationality and languages within these countries. When we remember that our national travail in Korea and disaster in Vietnam were in a very fundamental sense the result of our almost total ignorance of these two areas at the time when we first became deeply involved with them, we can see how important it is that somewhere in the United States there should be true expert knowledge on even the smaller nations and cultures.

5. *Some additional costs.* Some advanced language-training centers are necessarily located in foreign countries. Overhead costs for these centers are high. Throughout the field of area studies, translation costs are an important budget item. Finally, special costs, including those of complex exchange arrangements, are incurred in dealing with closed societies.

At the same time that expenses for foreign area studies have escalated, funding from each of the three major sources of financial support—the universities, the foundations, and the federal government—has declined.

Internal university funding of all fields has tended to shrink because of the general financial stringency in higher education, but, proportionately, foreign area studies have been harder hit than many of the more traditional branches of university activity, often because this field is newer and less firmly entrenched.

Support for international studies from foundations

has also been sharply reduced. In the four-year period from 1971 through 1974, foundation support for foreign area research to forty-four institutions responding to an American Council on Education survey declined by more than 13 percent.[1] In constant 1971 dollars, this represents a decrease of more than 56 percent in purchasing power. In part the reduction is the result of a sharp drop in funds available to foundations, but more important, it stems from the not unreasonable belief of many foundations that they should help pioneer new fields, but should not commit their funds to permanent support of projects, however worthy.

Finally, in this time of declining university and foundation support, the funding of key federal government programs in international education and research has faltered. During most of the 1960s, annual appropriations under Title VI of the National Defense Education Act stood at $16 million; the Fulbright-Hays Act added another $2 million yearly. By 1971, this $18 million total had been reduced to $8 million. As a result of congressional support in the face of adverse administration recommendations, funding has since been somewhat restored. In 1977, the appropriation for the Fulbright-Hays Act was $2.7 million and, for Title VI, $15.3 million. In the face of increased needs, spiraling costs, and the decline of other sources of support, however, this total of $18 million is now seriously inadequate.

The combined impact of rising costs and declining support from universities, foundations, and the government has set in motion a process of attrition in area studies. In 1973 the number of area and language centers funded under Title VI was cut from 106 to 50. The

Center for Chinese Studies at the University of Michigan, which received more than $2 million from the Ford Foundation between 1961 and 1975, now receives far less and has found no satisfactory alternative source of funding. The Russian Research Center at Harvard University has gone from an annual core budget of $300,000 in the late 1950s to about $100,000 in 1975-76 and about $50,000 in 1976-77. Yale's Southeast Asian Program has been liquidated altogether.

The effects of this attrition have been sweeping. Faculty positions have been lost, the recruitment of talented students has been impaired, curricula have been reduced, some fields of specialization have been sloughed off altogether, and library acquisitions and servicing have been sharply reduced. Fewer translations of foreign journals are available; fewer fellowships bring scholars to the major centers for periods of research and retraining. The number of college undergraduates studying languages other than English is decreasing by 15 percent annually. The number of American students who study abroad has been cut in half in the last three years.

To recover from such setbacks would not be easy even if more financing were to become immediately available. It takes time to build an institution, a staff, a faculty of experienced teachers and researchers, a library. Talent is hard to replace. Gaps allowed to occur in library collections may never be closed. The longer the decline in resources continues, the longer it will take to rebuild a minimum national capability in foreign area studies, when recognition of the need for such a capability is forced upon us.

In addition to in-depth knowledge of the foreign cultures and nations with which the United States must increasingly interact, our nation also needs a better understanding of a number of international problems and challenges that will confront us over the rest of the present century and beyond. The list of these problems is long and growing. Perhaps the most prominent, urgent, and stubborn are the control of and adjustment to population growth, the development and control of energy, the prevention of nuclear war, the improvement of agriculture and the just distribution of its products, the improvement of worth health and health-delivery systems, the management of international economic relations, the achievement of functional literacy in the third world, and the protection of individual human rights both from despotic government and from exploitive private interests.

Whereas in the case of foreign area studies the first order of business is to restore a level of health and performance which has recently declined, in the case of problem-centered research the first need is for recognition that the research universities can contribute far more than they do now to basic understanding of the issues posed by these enormous international problems. The experience in the field of arms control illustrates a general problem that exists in other areas of research as well. Although universities have much to contribute to the understanding of the scientific, political, and economic issues relating to arms control, they have received virtually no support from the federal government. The State Department has provided less than $20,000 a year

for university arms-control work, and the Arms Control and Disarmament Agency has been spending less than a million dollars a year for outside research (and almost all of that research is carried out by independent policy-studies institutes).

Similarly, in fields such as agriculture, health, and education, universities have not been encouraged to focus their Western research capabilities on the needs of the non-Western world. The scale of such research centers as now exist—on tropical diseases, on the physiology of reproduction, on comparative education, on economic growth and development—falls far short of the scale of the problems with which they deal and far short of what the research universities could be contributing to their solution.

This discrepancy between current research activity and current research needs is ably documented in a recent National Academy of Sciences study.[2] Some of the research opportunities cited in that study are these:

1. *Nutrition.* How do present diets affect human performance? How do government policies affect nutrition directly? What foods best satisfy nutritional needs under different circumstances and in different geographic areas?

2. *Food production.* Research on nitrogen fixation might greatly reduce dependence on costly oil-based fertilizers. Research on photosynthesis might find ways to increase by 50-100 percent the efficiency with which plants fix solar energy through photosynthesis. Other opportunities include work on plant resistance to pests and soil chemicals; pest management; weather prediction; soil and water management; the development of

farm production systems to optimize crop combinations, protection of soils, and crop handling.

3. *Food marketing.* In some countries, up to 50 percent of the food supply is lost between harvest and consumption. Research is needed to determine the causes of the problem and to devise appropriate strategies to eliminate them.

The Academy study recommends a series of major initiatives to meet these needs.

1. Increases of several hundred millions of dollars per year in Department of Agriculture funding, including a greatly augmented competitive grants program. (Only $1.25 million of the $623.75 million research budget of the Department of Agriculture is contracted out at present.)

2. Increases of up to $100 million per year to develop the facilities and equipment needed for first-rate research.

3. Reorientation of the $60 million now spent on nutritional studies each year by the National Institutes of Health; an emphasis on higher-priority research projects, such as epidemiological and behavioral studies.

4. Substantial increases in funding by the National Science Foundation for *basic* research in biology and other sciences underlying work in the field of food and nutrition.

Related to these research opportunities, the study continues, is the need to encourage the training of third-world students in the scientific and analytical skills necessary for conducting research on problems of agriculture and nutrition in their home countries and in the planning skills necessary for translating knowledge into

viable policies and programs. This point exemplifies the need for increasing the graduate-training opportunities for foreign students at the major research universities. Funding of such opportunities will require careful planning to ensure that the training given is truly relevant to the problems and conditions of the third-world countries.

In considering the best allocation of funds for research, it is important to note that the large international problems toward the solution of which universities can provide useful research and training do not lend themselves to approaches through the traditional departmental structure of the institutions. To work on issues such as population control or the improvement of nutrition, knowledge from many departments and professional schools must be brought together. Special organizations and structures must be created, with added costs.

## Internationalizing the Academic Disciplines and Professions

If, as we contend, knowledge of formerly "remote" areas is now as important to this nation as knowledge of the North Atlantic world, in the long run the study in universities of these areas will not be confined to the kind of foreign area and research centers we have just discussed. Just as new ideas, materials, and topics deriving from Western Europe are encountered throughout the regular departments of research and teaching and the professional schools, so their Asian and their African counterparts will in time achieve the same status.

This process of assimilating the less familiar world into the regular departments and schools is already under way in the major research universities, stimulated by the new contacts with that world which technical assistance and direct scholarly exchange have made possible since 1945. Younger scholars, many of them products of the foreign area training we have described, have brought their enlarged perspectives to established university departments seeking to extend their reach beyond the West. At the same time, some older members of established departments have extended the application of their disciplines to non-Western cultures and societies. In studying and helping to plan the course of the developing economies, for example, American economists have discovered some of the limitations and constraints that the transfer of Western models to developing countries faces. They must deal with societies that, perhaps, are both agrarian and densely populated, and they are forced to link economic planning with political and social considerations different from those of the developed countries. They have also acquired valuable knowledge of the special problems that the economies of the new nations face in their international transactions with the industrialized West. Whether or not these intellectual and practical contacts with third world economies will affect the theory of economics or only its range of application, economics as taught in American universities is becoming less provincial because of these contacts.

The study of political science is similarly affected. The emerging one-party states of Africa (neither wholly totalitarian nor wholly democratic) mix racial, tribal, and

regional interests with the most sophisticated Western political ideas and devices. In Asia, huge populations in China and India are attempting to improve their material condition under contrasting political systems, and China is adding a new and different chapter to the history of communism. The sensitivity of new nations to any threat to their sovereignty, and their apparent indifference to causes and interests that preoccupy the West, have become more understandable to Americans because of the enlarged scope of American scholars.

The tensions between old cultures and newly established polities, particularly in Asia, have engaged the attention of many sociologists and anthropologists, and some historians since World War II. Modernization and progress are now seen to have involved real losses as well as real gains, and there is now a greater readiness in American overseas activities to build on cultural values rather than bulldoze them.

Not all fields, however, have advanced as far in internationalization as have the social sciences.

The humanities have always demonstrated a somewhat remote respect for the high arts and venerable religions of Asia and a more condescending interest in the "primitive" arts and tribal gods of Africa. But the number of humanistic scholars whose work is centered in Asia and Africa has remained trivial in comparison with the number of Atlanticists in university departments of art, music, literature, history, and philosophy. As a result, most students of the humanities may know the path of duty expounded by Kant but not that set forth in the *Gita*, may know the *Iliad* but not the *Ramayana*, the sculpture of Athens but not the carving of Benin,

Chartres but not Nikko, the opera according to Bayreuth but not that according to Peking.

The professional schools of the universities have been particularly active in technical assistance since 1945. Schools of agriculture, business, education, engineering, law, and medicine have trained large numbers of third-world students, and many members of their faculties have gone abroad, as technical advisers, to work directly on problems of development and to help in the establishment and nurture of new institutions designed to give developing countries a permanent problem-solving capacity. To a limitied extent, the curricula and research programs of the professional schools now reflect this overseas experience, but on the whole these excursions by individual faculty members, and even technical-assistance partnerships with third-world universities, have remained exotic episodes, rarely reflected in the regular programs of the American partner. To a surprising degree, the crops and diseases, legal and educational systems, industrial cases, and appropriate technologies that are studied in American professional schools remain overwhelmingly Western, and the contributions to the solution of development problems in the third world which Western universities might make in collaboration with their counterparts in the developing countries are largely unrealized.*

*Although this discussion of the international reach of the disciplines and professional schools has emphasized attuning them to the non-Western world, we realize that the United States continues to have important interests in both Eastern and Western Europe. Our economic and political concerns there differ somewhat from those found in the third world, and it is essential to maintain research and training activities that draw stimulation from and contribute to the work of scholars in Europe.

## Needs and Recommendations

Since we have stated our belief that universities are by their very nature universal in their intellectual and scientific interests, it might be inferred that the further internationalizing of departments and schools may safely be left to the universities themselves and that, in the fullness of time, they will naturally become what they ought to be.

In theory, this would be a sound inference, and the obligation to proceed in this direction is justly placed on the universities. But, in practice, serious limitations over and beyond any lack of will stand in the way. The removal of these limitations cannot be accomplished by the universities alone, at least not in time to enable them to be fully useful to the nation and to mankind in the present century. Progress in enlarging the perspective of the universities remains limited and falls far short of what a full international competence requires. Only a small minority of faculty members have extended their disciplinary and professional reach since the Second World War, and both curricula and research programs continue to be heavily unbalanced. Even where greater balance has been sought, the "steady state" of university faculties since enrollment in higher education leveled off in the early seventies has meant that younger scholars who have specialized in non-Western areas or in Eastern Europe have often failed of appointment or, if appointed, have failed to receive tenure.

A second limitation, as we discussed in detail earlier, is the extremely high cost of the lengthy graduate training, language instruction, specialized libraries and other

facilities, as well as travel which international studies entail.

A third obstacle is a lag in the evolution of collaboration between American scholars and scientists and the growing number of able scholars and scientists in the developing countries. The day is past when Western scholars were free to study problems of their choice in the developing countries and when their relation to third-world scholars was largely tutelary. Arangements and resources are now needed to enable American and third-world scholars to collaborate as intellectual partners, both in the developing countries and in the United States. And it is equally important to maintain and enlarge scholarly collaboration between the United States and that segment of the developed world comprising Eastern and Western Europe and Japan.

The basic proposition we have offered in this section of our report is that the long-term international effectiveness of the United States would be substantially enhanced by the achievement of full international competence on the part of the major American research universities. We have also pointed out that, without appropriate federal assistance, even the competence that has been achieved since World War II will be eroded.

The objective of our national educational policy should not be simply to make use of the universities' existing resources for *ad hoc* research on the problems of the hour, but to develop in the universities an enlarged capacity to contribute year in and year out to our national understanding of the rest of the world. What forms of federal assistance would be most appropriate and effective in this situation?

## CAPACITY-BUILDING GRANTS TO RESEARCH UNIVERSITIES

The federal government currently administers a series of programs designed directly or indirectly to assist research universities in achieving high levels of international competence: fellowships and research grants from the National Science Foundation and the National Endowment for the Humanities, AID contracts for services to the developing world countries, research grants and contracts from mission-oriented departments and agencies such as the National Aeronautics and Space Administration and the Department of Agriculture, junior and senior Fulbright awards, NDEA Title VI area and language centers and programs, and external research contracts from the Department of State.

Most of these programs take for granted the existence of an infrastructure of international studies in American research universities. For reasons expressed and documented earlier, such an infrastructure cannot be taken for granted. Yet unless this basic capacity is in place, research universities will lose their ability to respond effectively to specific government-initiated programs and projects or to their own research and training priorities.

We believe that an adequate capacity in international studies can best be ensured by a program of federally funded institutional grants to universities, awarded through a nationwide competition based on merit. Judgments of merit should be based upon such criteria as the quality of the present faculty, the level of research activity, the size and quality of specialized library holdings, the university's plans for extending its research



139

on foreign areas and/or important international problems, the university's plans for achieving a better international balance in the research and advanced training programs of its regular departments and schools, and the demonstrated capacity and commitment of the university to share in supporting research and teaching on foreign areas and/or important international problems.

Since the development of an institutional capacity takes time, a program of capacitating grants should be carried on for ten years and should develop into a program of long-range support in a shared partnership of the government and the universities. Grants should be made for five years, with renewals based upon reviews to assess quality and effectiveness. It is particularly important to emphasize that the development of an adequate capacity for international studies is not a one-time task for either government or the universities. As with research in basic science, the need for international expertise and knowledge can only increase in a shrinking world. Most of the costs for international scholarly research have been and will continue to be paid by the universities, both public and private. But without continued partnership with a well planned and adequate federal program, these institutional efforts are doomed to inadequacy.

Although the overall objective is to attain and maintain a national capability, broadly balanced in its coverage of foreign areas, major international problems, and the principal disciplines and professions, in at least the first round of grants it would be better to build out from the resources, interests, and institutional plans of universities applying for support than to request or invite

applicants to fit into a national blueprint. Progress toward full competence is most likely if universities are helped to move in those directions and toward those tasks for which they are now, in their own best judgment, best prepared.

Grants might provide funding for any or all of the following, depending on the content of each university's development plan: special libraries; research fellowships for foreign and American scholars and scientists; initiating, conducting, and maintaining major research programs relating to foreign areas or international problems; support for post- and predoctoral students, publications, and travel; interdisciplinary programs in which several departments and professional schools work together on major international issues and problems.

**Recommendation 1**

**We recommend that, under the International Education Act or other appropriate authorizing legislation, the federal government develop a ten-year program of grants in support of plans by individual research universities for achieving and maintaining greater competence in research on foreign areas and international problems, and that these grants be awarded on the basis of demonstrated merit.**

## GRANTS TO INDIVIDUALS

Although for the next decade it is important to concentrate institutional grants in major research universities, other, less intensive programs should be made available in support of individuals capable of high-quality re-



140

search on international areas and problems. These programs should offer support to graduate students and postdoctoral scholars in international studies and related fields.

The graduate fellowships in international studies, awarded through a national competition, should provide for study abroad or at a university of the student's choice in the United States. In view of the long period necessary for training in some of the areas, these fellowships should be renewable in special cases for up to eight years, although five years should be the usual limit. For study abroad, travel funds should be provided, and the amount of the fellowship should be tailored to meet local living costs. For study at an American university, counterpart funds beyond tuition should be given to the university for overhead costs to help offset the financial drain occasioned by each additional graduate student.

The postdoctoral fellowships, also awarded in a national competition, should be designed to help scholars in international studies consolidate their specialized training and produce valuable scholarly results. Stipends should be proportionate to salary and to living costs in foreign countries, and travel expenses should be provided. For those scholars who wish to use these fellowships for research at university centers in the United States, the institutions selected should receive counterpart funds to offset the expense of library and other support for the visiting scholars.

Patently, such competitive fellowship programs must be developed in the context of existing fellowship opportunities, including the wide variety of federal scientific and cultural exchange programs. But these new

programs are essential because the number, level, and coverage of fellowships for international studies are still woefully inadequate. A new, overarching federal international fellowship policy needs to be developed in order to identify gaps in existing programs and in order to implement a larger and more comprehensive competitive fellowship system.

**Recommendation 2**

**We recommend the establishment of two nationally competitive, federally funded fellowship programs to support (1) the advanced training of graduate students and (2) the work of postdoctoral scholars in international studies.**

**Recommendation 3**

**Because of coverage gaps and other inadequacies in existing fellowship programs, we urge the development of a comprehensive federal fellowship policy.***

We should emphasize that an impressive national need for the expansion of international studies in the universities can be met for relatively little additional money. This added funding for capacity building grants, for international fellowships, for expanded area and language centers and programs, and for citizen education in global awareness could have a profound and salutary effect upon this nation's long-range capacity for pursuing effectively its growing international interests.

*As was suggested in the section of our report dealing with graduate education, the creation of a National Fellowship Commission, with members appointed by the President, would be one way to assure a comprehensive program of merit-based fellowships covering all fields.

**Recommendation 4**

**We recommend that the funding for present and future federal programs designed to increase our national competence in international studies be increased by approximately $75 million a year.**

NOTES

1. Higher Education Panel of the American Council on Education, *Foreign Area Research Support Within Organized Research Centers at Selected Universities* (Washington, D.C., 1976).

2. National Academy of Sciences, *World Food and Nutrition* (Washington, D.C., 1976).

## A NOTE ON THE PREPARATION AND AUTHORSHIP OF THIS REPORT

Topics for the papers that constitute this report were suggested by the university and foundation presidents who met on four occasions to discuss the government's relationship to universities. Some members of that group were the principal authors. McGeorge Bundy drafted the Overview; Meredith Wilson, former president of the University of Minnesota, assisted with an earlier draft. "The Critical Role of Basic Scientific Research" was prepared by Derek Bok, with assistance from a number of research scientists, particularly Professor Harvey Brooks of Harvard, and drawing on material developed by Francis Bello of *Scientific American.* The section of this report devoted to graduate education went through drafts by David Breneman of the Brookings Institution and by Roger Heyns, then president of the American Council on Education and now at the Hewlett Foundation. "The Major Research Libraries" was prepared by Warren J. Haas, vice president at Columbia University, and built upon an earlier draft by John McDonald, who was director of the Association of Research Libraries and is now director of the University of Connecticut Library. The paper with the most varied authorship is "Helping the Research Universities Achieve Competence in International Studies and Research." Professors Robert Ward of Stanford and Marshal Shulman of Columbia both prepared drafts. The final draft by F. Champion Ward of the Ford Foundation has been much assisted by the work of Stephen Bailey at the American Council on Education and the continuing interest of

Robert Ward. Professor Edwin Reischauer of Harvard and others were consulted along the way.

While major work has been done by all those named above, it is important to note that the original drafts of the several papers have been much changed by discussion at meetings and by circulation within the group of foundation and university presidents. Earl F. Cheit, dean of the Schools of Business Administration of the University of California at Berkeley, served as a consultant at all meetings of the presidents and on many aspects of the papers. The final drafts have been edited for publication by Mary Cox of Radcliffe College and the process of working through conferences, circulation of drafts, and editing was arranged by Harold Howe II and Peter de Janosi of the Ford Foundation.